

# Analysis of Detecting the Authenticity of Money Using the Edge Detection Method

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## Abstract

One of the factors causing the increase in the crime rate of counterfeiting banknotes is technological advances in digital printing. High-quality duplication makes it difficult to differentiate between genuine banknotes and fake banknotes. Traditional methods such as manually looking, feeling, and inspecting banknotes are becoming less effective, especially when dealing with large amounts. Image processing is an effective method for identifying the authenticity of money. Using a camera, images of real money and fake money are taken, then saved as a JPG file, and then the image is converted to greyscale followed by an edge detection process as a method of identifying the authenticity of the money. The two images produced from the edge detection process are then analyzed from the resulting edge lines and followed by a histogram and texture analysis which is used as a test parameter that can provide a better picture of the analysis results. Histogram analysis is carried out in the form of measuring the number of pixels and the distribution of pixel intensity resulting from images of real money and fake money. Meanwhile, the texture analysis carried out is in the form of sharpness and brightness resulting from images of real money and fake money. This research aims to determine the effectiveness of the edge detection method in identifying the authenticity of banknotes. The results of this research show that the edge detection method is effective in detecting the authenticity of money by looking at the histogram and texture analysis produced by images of real money and fake money. The resulting histogram shows that the number of pixels obtained is higher and the pixel intensity distribution obtained is more even or there is no significant change, so it is said that the image of money produced is real money, and vice versa. Meanwhile, for texture analysis, it was found that the brighter the color of the money image produced and the less conspicuousness that appears on the appearance of the resulting banknote image, the more the banknote image is identified as real money and vice versa.

*Keywords:* Edge Detection, Fake Money, Histogram, Real Money, Texture Analysis.

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## 1. Introduction

According to the KBBI (Big Indonesian Dictionary), money is a legal medium of exchange or standard of value. Money is issued by the government of a country in the form of paper, gold, silver, or other metals with certain shapes and images (M. Akbar, 2022). The development of money continues to progress with increasingly sophisticated technology. However, progress also opens up opportunities for crime. One of them is the widespread circulation of counterfeit money using technology (Sumardijanto et al., 2023).

From year to year, the circulation of counterfeit money continues to increase. According to Bank Indonesia (BI), as many as 188,370 counterfeit rupiah notes circulated in Indonesia from January to July 2021 with an increase of 43.16% compared to the same period the previous year, namely 107,058 notes (Dihni, 2021).

Color printers or digital printing with high print quality can help perpetrators of counterfeiting crimes (Sani et al., 2016). This results in difficulties in distinguishing between fake money and real money. Money checking, which is usually done manually by looking at, feeling, and looking at banknotes very carefully, becomes less efficient when you have to check a large number of banknotes in a short time. Apart from that, human limitations in carrying out the

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inspection process in this way increase the risk of negligence or misidentification of money (Alfita et al., 2022).

Various research continues to develop to create more effective methods for detecting the authenticity of money. (Pambudi et al., 2020) conducted research on detecting the authenticity of banknotes based on watermarks using digital image processing. In this research, the banknote watermark detection program using the canny edge detection method produced an accuracy of 85.71%.

(Ridwan et al., 2020) conducted research on the application of the Kirsch and Robinson edge detection method to detect the authenticity of banknotes. In this study, 48 data were tested and system results were obtained of 68.75% for system testing using the Kirsch operator, 62.5% for testing using the Robinson operator and 75% for testing using a combination of Kirsch and Robinson operators.

(Wishnuadji & Narendro, 2019) conducted research on counterfeit money detection using digital image processing methods using edge detection and histograms. In this research, a JPG format file was used which was then converted to greyscale, and then an edge detection process was carried out on the image followed by creating a histogram. The result of this research is that the edge detection method can distinguish between real money and fake money.

Texture analysis can improve the identification of the authenticity of money using the edge detection method. Processing an image to obtain the physical characteristics of rupiah banknotes requires texture analysis to be able to provide more accurate identification results (Zulfiansyah et al., 2023).

Judging from the above background, the researcher intends to find out the effectiveness of the edge detection method in detecting the authenticity of money seen from the histogram results and the resulting texture analysis.

## 2. Method

The research method used is experimental research to determine the effectiveness of the edge detection method in detecting the authenticity of money seen from the edge detection results caused by the image results produced from real money and counterfeit money. In addition, researchers also conducted histograms and texture analysis produced (Puspita, 2020). Researchers carried out tests using two samples of banknote images, namely images of real banknotes and images of fake banknotes (play money) with a nominal value of Rp. 50,000 and Rp. 100,000. The figure 1 is the research concept carried out.

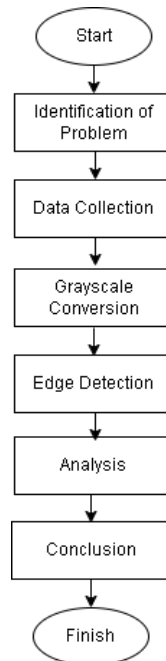


Fig. 1. Research Concept.

### 2.1. Identification of Problem

The initial stage of this research is identifying the problem to be studied. At this stage, the main problem discussed is the widespread circulation of counterfeit money, especially banknotes, which is accompanied by increasingly sophisticated technological developments (Sumardijanto et al., 2023). This prompted researchers to carry out tests using edge detection as a solution to identify the authenticity of banknotes using histogram test parameters and analysis of the resulting texture.

### 2.2. Data Collection

At this stage, the researcher collects data through literature studies and primary data. The literature studies used come from articles, journals, and several books related to edge detection methods used to detect the authenticity of money (Ptr et al., 2023). Primary data comes from taking images of original banknotes issued by Bank Indonesia and images of fake banknotes (play money) with a nominal value of Rp. 50.000 and Rp. 100.000 using the camera directly and each taken in JPG format. The following is an image of the primary data used as a sample:



**Fig. 2.** Real Money

**Fig. 3.** Fake Money

### 2.3. Greyscale Conversion

Images used as test samples are first converted to a gray scale to obtain intensity information that is easy to process rather than processing images in RGB (Red Green Blue) conditions (Bashori et al., 2023). The greyscale conversion shown on Fig. 4 and 5.

### 2.4. Edge Detection

At this stage, the edge detection process aims to identify points or edge lines in the digital image where the image brightness changes sharply or has discontinuities. The border will be detected in the grayscale of the currency note. The image will be smoothed and to obtain the basic shape of the image, the edge detection process is carried out before the shape feature extraction process. This can increase the appearance of the boundaries of an area or object in the image (Puspita, 2020).

### 2.5. Analysis

This stage is carried out to identify the authenticity of the money after the edge detection process. The analysis carried out is based on the histogram results and image texture analysis of real money and fake money (play money) using LBP (Local Binary Pattern). The histogram shows the distribution of pixel intensity in the image on the graph, with the x-axis indicating the pixel intensity or brightness level, and the y-axis indicating the number of pixels with that intensity (Ratna, 2020). The resulting histogram is a graph of intensity and number of pixels. The higher the intensity and number of pixels produced from the money image, the more the money image is identified as fake money, and vice versa (Fatimatuzzahro & Yuliantari, 2021). Meanwhile, the texture produced by the money image after the edge detection process, the smoother the texture of the resulting money image, indicating that the money is real money and

the sharper contrast in the appearance of the money image shows that the money is fake money (S. Akbar et al., 2023).



Fig. 4. Greyscale Conversion of Real Money



Fig. 5. Greyscale Conversion of Fake Money

## 2.6. Conclusion

Conclusions include answers to the problem studied, research objectives, and recommendations for readers. It also illustrates the impact of the research.

## 3. Result and Discussion

### 3.1. Edge Detection

The edge detection method is an image analysis process that aims to find significant changes in pixel intensity by forming lines or edges on objects in the image. The result of this method will be a new image that highlights the structure and boundaries of the object, which makes further image processing analysis easier. Researchers carried out this method to detect the authenticity of banknote images taken directly using a cellphone camera. The image of the banknote used has a nominal value of Rp. 50.000 and Rp. 100.000. The fig. 6 show the results of the edge detection method.

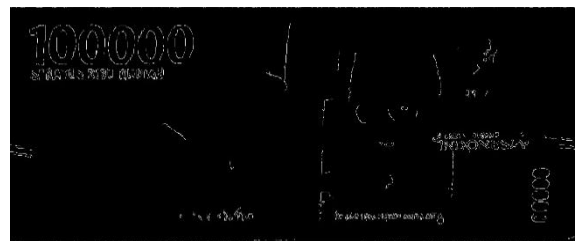
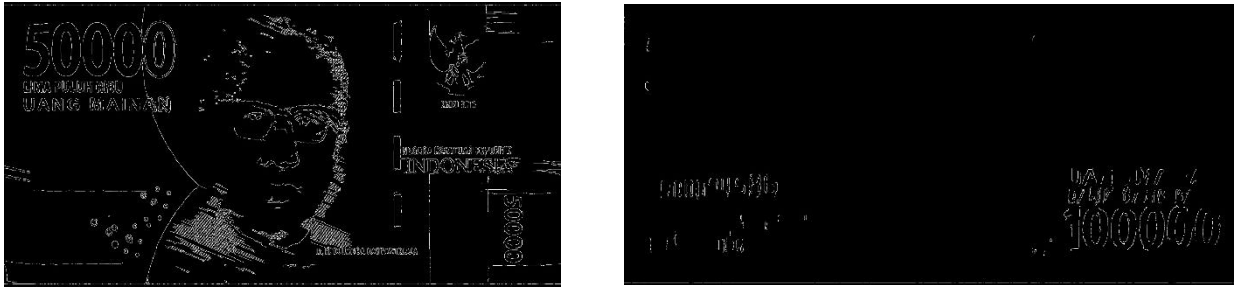


Fig. 6. Edge Detection of Real Money

Fig 6. Shows the results of applying the edge detection method to images of original banknotes with a nominal value of Rp. 50,000 and Rp. 100,000. The results obtained show several lines or edges on the original banknote image object. However, the edge detection resulting from the texture is sharper, so the image of the banknote is indicated as real money.



**Fig. 7.** Edge Detection of Fake Money

Fig 7. Shows the results of applying the edge detection method to images of original banknotes with a nominal value of Rp. 50,000 and Rp. 100,000. The results obtained show several lines or edges on the original banknote image object. However, the edge detection caused by the texture is smoother, so the image of the banknote is indicated as fake money.

### 3.2. Histogram

Apart from detecting the edges generated in the images of real banknotes and fake banknotes, there are also histogram results obtained from the images of real banknotes and fake banknotes. Histogram image produced from images of real banknotes and fake banknotes shown on Fig. 8.



**Fig. 8.** Histogram Real Money

Fig 8. is a visualization of the histogram image of original banknotes with a nominal value of Rp. 50.000 and Rp. 100.000. This image was taken directly via a cellphone camera, then first converted to grayscale, and then processed using the edge detection method. The results of the histogram show that the pixel intensity has an even distribution with a range of 0-200 and the number of pixels obtained ranges from 0-800000 so that the image is identified as an image of genuine banknotes.

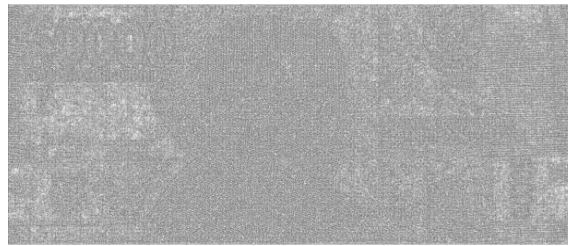


**Fig. 9.** Histogram Fake Money

Fig 9. is an image of the histogram image of fake banknotes with a nominal value of Rp. 50.000 and Rp. 100.000. This image was taken directly via a cellphone camera, then first converted to grayscale, and then processed using the edge detection method. The results of the histogram show that the pixel intensity has an uneven distribution with a range of 0-200 and the number of pixels obtained is in the range of 0-600000.

### 3.3. LBP Texture Analysis

The texture analysis process used to identify the authenticity of money uses LBP (Local Binary Pattern). According to (Lodong et al., 2023) LBP is a grayscale image technique that is effective for describing texture, has accurate distinguishing power, and is tolerant of changes. Researchers carried out image texture analysis of real banknotes and fake banknotes to find out the characteristics of real banknotes and fake banknotes. The results of texture analysis using LBP shown on Fig. 10.



**Fig. 10.** Texture Analysis Real Money

Fig 10. is Figure 8 is a picture of an original banknote with a nominal value of Rp. 50.000 which had previously been converted to greyscale, then the Edge Detection method was used to determine the authenticity of the banknote image. The texture results of this image show that it does not have a striking area and the color of the image is brighter so that the image of the banknote is identified as genuine and the image of the original banknote has a nominal value of Rp. 100.000 produce the same texture analysis.



**Fig. 11.** Texture Analysis Fake Money

Fig 11. is a picture of fake banknotes with a nominal value of Rp. 50.000 which was previously converted to grayscale, then the edge detection method was used to determine the authenticity of the banknote image. The texture results in this image show a prominent area and the image appears darker so that the banknote image is identified as fake. And for the image of banknotes with a nominal value of Rp. 100.000 produce the same analysis texture.

## 4. Conclusion

From the results of the analysis conducted using the edge detection method, several conclusions can be drawn:

- The edge detection method is proven to be able to show effectiveness in detecting the authenticity of money with test parameters from histograms and texture analysis using LBP (Local Binary Pattern).
- The histogram results show information about the frequency of occurrence of intensity values and the number of pixels but do not provide specific details on the authenticity of the banknotes. Significant differences in the histogram may indicate the presence of money falsehoods. The indication of counterfeit money is shown in the number of pixels is smaller, but the distribution of pixel intensity is greater than the real money histogram, that is, the number of pixels indicated by the image of counterfeit money shows a range of 200000-600000 and intensity distribution.
- The results of texture analysis produced using LBP (Local Binary Pattern) show that the brightness shown by the image of money indicates the authenticity of money. The appearance of attributes on the image of money that is more prominent shows that the money is counterfeit.

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