http://infor.seaninstitute.org/index.php/infokum/index
JURNAL INFOKUM, Volume 10, No.4, October 2022 ISSN : 2302-9706

# IDENTIFICATION OF AUTHENTICITY BASED ON DIGITAL IMAGES USING LOCAL BINARY PATTERN AND SUPPORT VECTOR MACHINE METHODS

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Article Info
Received, 3/10/22
Revised, 11/10/22
Accepted, 21/10/22

Abstract

Technological progress has an influence on development. Where the influence that arises can be in the form of positive or negative influences related to community behavior in utilizing and applying existing information technology. Paper money is a basic need in a society where its use is as a means of payment, either in cash or electronically. Counterfeit money is a currency whose production is carried out without any legal approval from the state or government on the official website of Bank Indonesia. Counterfeit money in Indonesia from 2014 to 2018 has decreased and increased on a national scale. In this study, the authors want to make a study to be able to distinguish counterfeit money or real money with the concept of Computer Science in the field of image processing using extraction and classification techniques. In this study, the extraction technique used is texture extraction with LBP and Classification using SVM to be able to recognize the authenticity of banknotes using the MATLAB application as a means to complete the analysis process.

Keywords: Banknotes, LBP, SVM, Extraction, and Classification

## 1. INTRODUCTION

In modern times like today, there are many various fields that are undergoing development, one of which is the field of information technology whose development is considered very fast and has a great impact on humans. The application of information technology by the community can have a positive and negative effect on people's behavior. Along with these developments, there are also many crimes that use technology. One of the most common criminal cases is counterfeit production. Money is a basic need of society for transactions, whether done electronically or in cash. [1]

The Indonesian government has a state bank, namely Bank Indonesia, whose function is to print money by making a special appointment to a printing company to print money that has validity for use in transactions by the Indonesian people. It is recorded on the official website of Bank Indonesia that counterfeiting money in Indonesia from 2014 to 2018 has decreased and increased on a national scale. Meanwhile, in 2014 there were 126,417 counterfeit notes found in circulation. Meanwhile, in 2015 it increased to 319,681 shares. In 2016, there were 362,250 counterfeit notes in circulation, which means that it has increased again from the previous year. In 2017 there were 164,903 counterfeit notes in circulation, which means a decrease from the previous year. In 2018 there were 237,431 counterfeit notes in circulation.[2]

In this study the author wants to make a study to be able to distinguish counterfeit money from real money by applying the concept of Computer Science in the field of image processing using extraction and classification techniques. The extraction method applied in this research is Local Binary Pattern (LBP) and Classification using Support Vector Machine (SVM). This research was taken with the aim of making a scientific contribution in the field of image processing to be able to

recognize the authenticity of banknotes using the LBP texture extraction technique and the SVM classification technique where the scientific contribution given is in the form of information contained in the form of articles, theses, mass media and journals. Detection of counterfeit money has also been tested using the kmeans clustering method. The results obtained are quite good with 96% accuracy. The difference between this study and research - previous research lies in the processing images that are not carried out through ultraviolet light but by using a smartphone camera as automation of gadget use by using LBP and SVM methods that are able to provide excellent results good.

## 2. METHOD

### 2.1 Definition of Image

Humans are visual creatures, where by relying only on the sense of sight, humans can understand various things that are happening around them. When humans are looking at something, they not only identify and classify but also know about the differences and can feel them quickly.[3] The human eye can easily adapt and interpret an object to obtain information, which in the real world an object can change either due to time, the influence of light or shadow. Image can be interpreted as a function of two variables, for example a(x,y) where a is the image amplitude at coordinates (x,y). [4]

Image is a resemblance, representation or imitation of an object. An image contains a variety of information about the object being represented. Images can be categorized into two, namely visible and invisible images. In order to be able to reach the view of the previously invisible image, it must be converted into a visible image, for example it can be displayed with the help of a monitor layer, printed on paper and so on. One example of an invisible image is a digital image. [5]

### 2.2 Local Binary Pattern (LBP)

Local Binary Pattern was originally introduced by Ojala et.al, which is termed as a texture measure of invariant grayscale, which can be said to be invariant because it is almost not affected by different lighting. LBP is considered good in describing a texture, has a distinguishing power with high accuracy and has tolerance for changes that occur in monotonic grayscale.[6] One method that is considered quite reliable in extracting texture features is the Local Binary Pattern (LBP), because LBP has the advantage that it can describe the texture characteristics that exist in the image surface. [7]

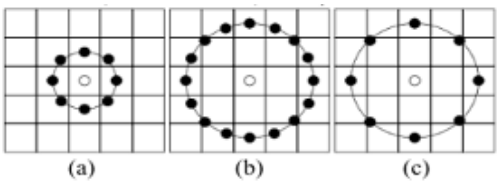


Figure 1. Distance and Neighbor Pixels

### 2.3 Support Vector Machine (SVM )

Another advantage of the SVM method is the speed of the learning process. SVM is a method that can be said to be new compared to other methods. However, SVM has better performance in various application fields such as bio-informatics, handwriting recognition and text classification. [8]

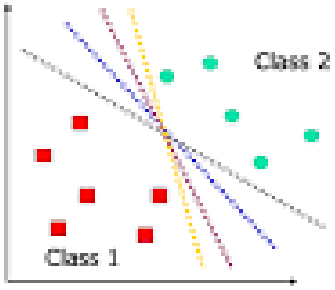


Figure 2. Illustration of Class Separation in SVM

System testing will be carried out to determine the process of identifying the authenticity of banknotes based on the texture of money using LBP and SVM. The extraction process with LBP and SVM is carried out using the system that has been built. The application of this system is to identify the authenticity of rupiah banknotes based on texture. [9] This research is used by inputting the image of banknotes on an already available system, then processing the image of banknotes using the LBP and SVM methods in order to obtain image extraction results and identify the authenticity of banknotes based on the texture of the money. [10]


Figure 3. LBP And SVM Algorithm Flowchart

## 3. RESULTS AND DISCUSSION

In identifying the authenticity of banknotes based on digital images using the LBP and SVM methods, the data used are digital images of the Rp. 50.000,-. After the data is obtained, then the next describes how to process the data. The analysis stage aims to analyze the data that has been obtained wherein the stage of the feature extraction process for digital banknotes is carried out using Local Binary Pattern (LBP) texture extraction with indicators namely Mean, Variance, Skewness, Entropy and kurtosis. Furthermore, the categorization process will be carried out with the Support Vector Machine (SVM). The steps for managing the data obtained include:

1. Provide digital images of Rp. 50.000,- RGB type measuring 480 x 640 pixels as data for testing.
2. The RGB image is then converted to a grayscale image.
3. Applying the Local Binary Pattern (LBP) texture extraction method to extract the texture of the Rp. 50.000,- with indicators namely Mean, Variance, Skewness, Entropy and kurtosis.
4. Apply the Support Vector Machine (SVM) algorithm to classify the authenticity of banknotes obtained from the extraction of the Local Binary Pattern (LBP) method.

The data used is in the form of an RGB image with a size of 480 x 640 pixels which will be used to identify the authenticity of banknotes based on texture using LBP and SVM, but to test samples using the LBP (Local Binary Pattern) method, the research will crop the image of banknotes. used to be 9x9 pixels in size.


Figure 4. Sample Digital Image of Banknotes Rp. 50.000,-

Table 1. Image Sample

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 111 | 109 | 112 | 109 | 108 | 107 | 110 | 111 | 110 |
| 110 | 115 | 109 | 108 | 110 | 115 | 109 | 109 | 114 |
| 109 | 107 | 110 | 121 | 111 | 107 | 112 | 109 | 115 |
| 108 | 113 | 105 | 104 | 108 | 112 | 109 | 107 | 112 |
| 104 | 106 | 109 | 107 | 108 | 111 | 108 | 104 | 106 |
| 111 | 108 | 107 | 111 | 110 | 103 | 103 | 111 | 106 |
| 107 | 107 | 112 | 108 | 102 | 99 | 108 | 109 | 104 |
| 113 | 109 | 107 | 101 | 112 | 113 | 103 | 105 | 106 |
| 112 | 106 | 110 | 108 | 106 | 102 | 111 | 101 | 110 |

The sample image above is a digital image of the Rp. 50.000, - which has a value for each pixel, where the image is a grayscale type that has gone through preprocessing with a size of 9 × 9 pixels. The image sample consists of 9 rows and 9 columns that will be used in performing the stages of classifying the authenticity of banknotes by applying the LBP method. While in the application of the SVM (Support Vector Machine) method using a digital image sample of the Rp. 50.000, - and Rp. 100,000 according to the system created. If you are ready to process the data, the next step is to run the feature extraction process. Texture feature extraction from training data is an image process to predict texture feature extraction to get the value of image data on banknote data. The feature extraction used is LBP feature extraction with indicators of Mean, Skewness, Variance, Entropy, and kurtosis. This feature extraction process produces an indicator of the LBP texture extraction value. In calculating the LBP extraction, this research applies a comparison of the pixel value in the center of the image with the value of 8 pixels around it to obtain a local binary pattern extraction indicator. then in getting the indicator value extraction Local Binary Pattern will be done computerized using MATLAB tools.

Table 2. Image Pixel Value to be Extracted

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 111 | 109 | 112 | 109 | 108 | 107 | 110 | 111 | 110 |
| 110 | 115 | 109 | 108 | 110 | 115 | 109 | 109 | 114 |
| 109 | 107 | 110 | 121 | 111 | 107 | 112 | 109 | 115 |
| 108 | 113 | 105 | 104 | 108 | 112 | 109 | 107 | 112 |
| 104 | 106 | 109 | 107 | 108 | 111 | 108 | 104 | 106 |
| 111 | 108 | 107 | 111 | 110 | 103 | 103 | 111 | 106 |
| 107 | 107 | 112 | 108 | 102 | 99 | 108 | 109 | 104 |
| 113 | 109 | 107 | 101 | 112 | 113 | 103 | 105 | 106 |
| 112 | 106 | 110 | 108 | 106 | 102 | 111 | 101 | 110 |

1. Divide the image matrix into smaller parts which are usually called kernels, namely the 3x3 matrix. Comparing the pixel value at the center point with 8 neighboring points. If the

neighboring point's pixel value is greater than or equal to the center point, then it is given a value of 1.
2. The value is arranged in a clockwise direction which will later become an 8-bit binary number.
3. Conversion of binary numbers to decimal by multiplying the binary value by the exponential number of the 2 decimal values obtained, then it will become the LBP value in a kernel.

Table 3. Histogram Normalization Results

| $f_n$ | $n_i$ | $p(f_{n)}$= ni/n (n-49) |
|---|---|---|
| 0 | 7 | 0,143 |
| 2 | 2 | 0,041 |
| 4 | 1 | 0,020 |
| 12 | 1 | 0,020 |
| 16 | 1 | 0,020 |
| 32 | 1 | 0,020 |
| 33 | 1 | 0,020 |
| 46 | 1 | 0,020 |
| 49 | 1 | 0,020 |
| 52 | 1 | 0,020 |
| 63 | 1 | 0,020 |
| 94 | 1 | 0,020 |
| 112 | 1 | 0,020 |
| 118 | 1 | 0,020 |
| 127 | 1 | 0,020 |
| 129 | 1 | 0,020 |
| 139 | 1 | 0,020 |
| 140 | 2 | 0,041 |
| 142 | 1 | 0,020 |
| 159 | 1 | 0,020 |
| 172 | 1 | 0,020 |
| 179 | 1 | 0,020 |
| 191 | 1 | 0,020 |
| 207 | 2 | 0,041 |
| 211 | 1 | 0,020 |
| 217 | 1 | 0,020 |
| 222 | 1 | 0,020 |
| 223 | 2 | 0,041 |
| 239 | 1 | 0,020 |
| 252 | 1 | 0,020 |
| 254 | 1 | 0,020 |
| 255 | 7 | 0,143 |
| 234 | 1 | 0,020 |

After receiving a new image from the Local Binary Patter feature extraction and taking the histogram value, the next step is to calculate the value indicator of the Local Binary Pattern (LBP) texture extraction histogram with the system that has been created. Calculations to get the indicator value from the extraction of Local Binary Pattern (LBP) on the new image extracted from the Local Binary Pattern (LBP) texture which will be used as a feature of the image. The indicators of the value of the extraction of the Local Binary Pattern (LBP) in this study are the Mean, Entropy, Variance, Skewness and Kurtosis. The calculation of the value indicator of the extraction of the Local Binary Pattern uses the histogram value of the extraction of the Local Binary Pattern (LBP).

3.1 System Testing


Figure 5. Image Input Display Form


Figure 6. The Process of Testing the 1st Data


Figure 7. 2nd Data Testing Process

In the banknote image classification process using Local Binary Pattern extraction and Support Vector Machine classification above, the inputted image is a banknote image with the original file name_50_11.bmp sized 480 x 640 pixels. To carry out the classification process, image input is

carried out by pressing the 'select image' button, the system will display the selected image, namely Asli_50_11.bmp.

Then before the image classification is carried out, firstly it is extracted by pressing the 'feature extraction' button, the system will display the image from the feature extraction of the Local Binary Pattern as well as display the indicator value of the result of the Local Binary Pattern feature extraction with a value of Mean = 4.3356 Entropy = 3 ,0992 Variance=84,0241 Skewness = 4,229 and Kurtosis = 17,9152. Next, the image classification process is carried out on the original_50_11.bmp file by pressing the 'identify' button, the system will display the classification results of the inputted image. It can be seen in the identification process of banknotes above, the image identification results in the original_50_11.bmp file are the original Rp. 50,000, so it can be said that the results of the image classification process in the original_50_11.bmp file are correct.

## 4. CONCLUSION

The conclusions obtained from the discussion and data analysis include: To identify the authenticity of rupiah banknotes, it can be done using the Local Binary Pattern Feature Extraction method and the Support Vector Machine method from the feature extraction results, both in the form of colors, textures, and numbers on the banknote image and greatly affects the level of accuracy produced with the highest accuracy of 99 %. In addition, the cropping process on the image and the pixel size of the image, also affects the level of accuracy produced. The larger the pixel size of the image, the higher the accuracy can be achieved and if the pixel size of the image is small, the accuracy will be poor.

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