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Signature Recognition with Zernike Moment Method Using Support Vector Machine

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Abstract :

The signature is one of biometrics owned humans that are written in a special way and have a different signature pattern between each other. The signature is typically used as the main mechanisms in States that the parties signed, knowing, approve and is responsible for the entire content of the document. However, the forgery of signatures still often occurs and is detected it will be difficult if done by the party that is already trained. Thus, required the existence of an application that can help identify a person's signature to minimize the practice of pe malsuan signature. This research proposed a system to identify the signature extraction characteristics of Zernike Moment, in order to match the right consistency and the degree of accuracy of the signature using the method of Support Vector Machine. Size, shape, pressure, and position of the signature being the main factors influencing the process of identification. Before the extraction process characteristic of Zernike Moment done cropping process against the next image done praproses grayscale and binarisasi. The next stage of the process of classification in order to recognize authenticity while counting accuracy against the method of Support Vector Machine. From the research that has been done to the 23 employees produce value accuracy of 88%.

Keywords— **Signature, Digital Image, Pattern Recognition, Support Vector Machine, Zernike Moment.**

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1. INTRODUCTION

A signature is used as the primary mechanism in suggesting that the parties signed, knowing, approve and responsible for the content of the document. In this study the introduction of a signature is required to identify the authenticity of the signature of the document. Because the forgery of signatures can be easily done by anyone and are often undetectable.

For example when a signature is used for power of Attorney, receipt of goods, a news event ready operation and other documents. Then in the absence of a system that is able to recognize your signature, then someone will can easily forge the signatures of others. So as to allow the document signed by a person who does not have the authority. This is certainly going to negatively affect when the document is processed further.

Based on the analysis for the study above, required the existence of a system that is easy to use to help in recognizing someone's signature so that in case of the existence of counterfeiting signatures for document processes can be avoided. In this research will be designed a signature recognition systems using desktop-based extraction of characteristic Zernike Moment and method of Support Vector Machine.

2. RESEARCH METHODS

2.1 Review Of The Literature

All transactions made that directly relate to the validity of new correspondence can be said to be legitimate or if it is already affixed your signature to the two sides of the seller or buyer that can minimize the occurrence of problems the next day whenever possible be solved by way of family for not deviating from the Treaty in the eyes of the law. It would seem the obvious benefits of the signature as it does as a means of authentication and verification:

1. Identify the attributes of the signer and the correctness of the contents of the document that is signed.
2. Shows the language really people who signed an agreement in accordance with its own identity card as well as agree to the clauses in the agreement and acknowledge the truth of what is expressed therein. The agreement is a manifestation of assent over substance through a contract made by the parties. Because the absence of the signature of a treaty would not be known who the parties that make it and there is no agreement over the articles.

Analyze handwriting through lies, of course, would be very useful in criminalistics that in it there is mention that the Graphology method [1]. Such is the case that when a person is lying no signature will appear natural behavior or lack of natural behaviour that can tell which captions written honestly and which ones have been manipulated.

It should be noted, that to conclude whether a signature is made honestly or has been manipulated, it cannot be determined from just one indicator [2]. However, it is necessary to analyze the entire writing or signature, and also look for other indicators.

This is done so doesn't have an impact on making wrong conclusions. All indicators that appear, must be mutually confirmed and evaluated. Many researches have applied digital image processing with Matlab language for various fields from health, biology, robotics and so on [6].

2.1.1 Support Vector Machine Method

Types of classification methods is integrated (supervised) because when the training process required a specific learning target. Support Vector Machine is an algorithm that works using a nonlinear mapping to change your original training to higher dimensions. In this new dimension will be looking for a finite hyperplane for separating the right to fairly high dimensions.

Support Vector Machine first appeared in 1992 by Vladimir Vapnik together with his colleague Bernhard Boser and Isabell Guyon. The basis for Support Vector Machine already exists since the 1960 's (including early works by Vapnik and Chervonenkis Alexei on learning theory statistics "). Method of Support Vector Machine is used to detect and to verify the accuracy and classifying bunches of hand where the system uses global recognition, directional and grid features. But weak in occultation and non-grid deformation.

Support Vector Machine classification problem solving by finding the maximum marginal hyperplane where there are an infinite number of hyperplanes to look for where the best. In intuitis, the hyperplane with a larger margin more accurately classify the data compared with a smaller margin.

Support Vector Machine with the biggest margin hyperplane finding known as the Maximum Marginal Hyperplane (MMH).

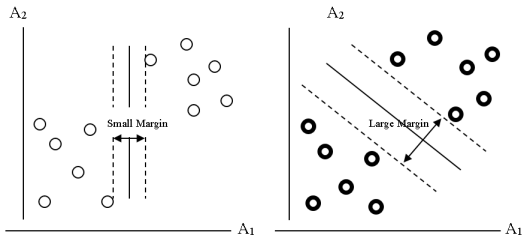

Image 1. Small Margin and Large Margin.

For larger data more efficient and special algorithm for Support Vector Machine can be used as an alternative with a rewrite MMH as boundary decision:

$$d(XT) = \sum_{i}^{l} = 1 y_i \alpha_i X_i XT + b\alpha$$

where yi is the label class support vector Xi. XT is a type of test, αi and b0 the numeric parameter is determined automatically by the optimization algorithm of Support Vector Machine and 1 is the amount of support vector and αiis the Lagrange multiplier for separate data linearly. There are two groups of data and data points separated by adequate where we can draw a straight line on the picture with all the points one kelasa on one side of the line and all points from other classes on the other hand the line [4].

2.1.2 Zernike Moment Method

Zernike Moment was first introduced by f. Zernike in his book titled Pahysica which was published in 1934 and its application for image processing introduced doleh Teague in 1980. When viewed from the side of the calculation, Zernike Moment involving a more complex calculation as compared with other methods such as Geometric types as well as Legendre Moment. However, Zernike Moment has already proven to be one of the good feature of extraction methods because of its ability to represent an image of who experience distortion and rotation. Zernike Moment was chosen because it is invariant to rotations and are not sensitive to noise, another advantage of the Zernike Moment is the ease of reconstruction image due to orthogonalnya.

Zernike Moment is included in the region based shape descriptor. This type of method is known to be very efficient in its use and pattern recognition, because it has the orthogonality of Zernike Polynomials in the results of feature extraction that is formed and has properties that do not depend on the image ritation. Has an invariant rotation function where the Zernike Moment will not change with the rotated image. The following

equation is used to find Zernike Moment from an image.

R = the set of real numbers;

Z = the set of complex numbers;

Zernike Moment is a collection of polynomials which have a form of the equation as follows:

$V_{nm}(\rho,\Theta) = R_{nm}(\rho)\ exp\ (jm\ \Theta)$

Where*n*is the number of positive integer or zero, *m*is the number of integers less than or equal to*n* and *n-lml*is even, *p* is the length of vector and Θ is the angle of the vector*p*. Zernike Moment Anm ϵ Zfrom an image*f*can be defined as follows:

$A_{nm} = \frac{(n+1)}{\lambda}\iint_{x^2+y^2 \leq 1} R_{nm}(\rho)e^{-jm\Theta}f(x,y)dxdy$

Zernike Moment is the set of complex-valued orthogonal polonomial.

$V_{nm}(x,y) = R_{nm}(x,y).exp(jm\ tan^{-1}\left(\frac{y}{x}\right))$

Where :

$x^2 + y^2 = \leq 1.\ j = \sqrt{-1}, n \geq 0,\ |m| \leq n$

and*n-*,*|m|* is even and radial polynomials (R_{nm}) defined as follows:

$R_{nm}(x,y) = \sum_{s=0}^{\frac{n|m|}{2}} B_{n|m|\,(x^2+y^2)^{\frac{n}{2}}} s$

2.2 Previous Research Study/Review

Here are some related research summary:

1. Endina Princess P., Diyah Puspitaningrum and Andre Mirfen in 2015 conducted research with the title "identification with a Signature approach to Support Vector Machine". The research indicates that: (1) the larger the size of the zone then the higher accuracy of identification; (2) the smaller the polynomial degrees then the higher accuracy of identification; (3) the best performance is obtained for the size of the zone of 5x4 and polynomial degree 2 with the percentage accuracy of identification of 97.33%.
2. Cahya Hijriansyah and Achmad Solichin categories: in the year 2016 do research with the title "identification With Signature characteristic of Fractal and the calculation of the distance Enclidean At Faculty of information technology of the University of Budi Luhur". From signature identification testing that has been done against the 60 students produce a value False Rejection Rate (FRR) of 24% and False Acceptance Rate (FAR) of 30%. Size, shape, pressure, and position of the signature being the main factor of success in the identification process.
3. Difla Yustisia Qur'aniland Safrina Rosmalinda in the year 2010 do research with the title "Neural Network Vector Quantization for the application of Learing Introduction signature". From the results of a test program indicate that JST LV Neural Network Vector Quantization can identify Learing patterns are the signature with the accuracy of 98% in the test data. The possibility of inaccuracy is due to different test image position a bit far with the image-the image training.
4. Vineeta Malik and Anil Arora in the year 2015 to do research with the title "Signature Recognation Using Matlab". In this research, signature recognition systems that exist have been completely studied and models designed to develop a system of recognition of signatures offline.
5. R. Arum Kumalasanti., Ernawati., B. Yudi Dwiandiyanta in the year 2015 to do research with the title "Static Signature Identification using a Backpropagation Neural Network And Wavelet Haar". Of research results obtained optimal results by using a Neural Network with two hidden layers, respectively 20 and 10 nodes, over the range wavelet Haar at level 4, the learning rate is 0.12. Training and testing on this identification phase, each providing the accuracy of 95.56%.
6. Ravinder Kumarl and Poonam Singhal in the year 2017 doing research with the title "Signature Verification Using Support Vector Machine". From the results of research, the system uses features extracted from the signature such as the barycenter, wide ratio is high, the total surface area, the first and second derivatives, the quadrants, etc. After verification, the signature feature of the angle used on a fuzzy logic-based system for the detection of forgeries. and its performance increased (approximately 80%) when using Support Vector Machine classifier as.

2.3 Review Of The Research Object

In this study the authors focus on the object of studies on the accuracy of the signature in PT Farsiendo Nice Comm is a company engaged in Network Equipment and IT Network Consulting based in Kebon Jeruk Business Park Block C1-10 Jl. Meruya Ilir Raya Kav. 88 West Jakarta. PT Farsiendo Nice Comm trying everything possible to provide the best service and solutions to meet the customer's wishes in the problems of the network. PT Farsiendo Nice Comm established since November 25, 2009 and committed to always

providing the best service in the advancement of telecommunication in Indonesia.

2.4 Concept/Framework For Problem-Solving Mindset

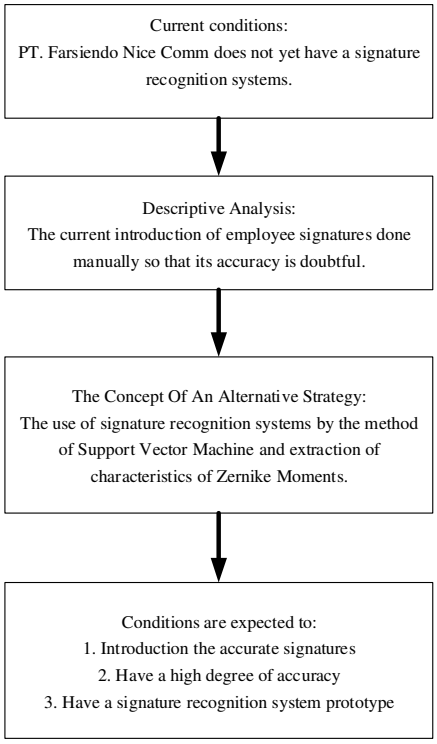

Image 2. Problem-Solving Thinking Framework.

2.5 The Hypothesis

Allegedly with this research that uses Zernike Moment and characteristic extraction method of Support Vector Machine is expected to recognize a signature to avoid forgery of signatures.

3. RESULTS AND DISCUSSION

3.1 Research Methodology

This research uses a type of experimental research, early stage research collecting data signature is obtained by asking the help of employees of PT. Farsiendo Nice Comm as much as 23 employee to affix the signature on 9 sheets the paper is provided in the table measures 4 x 5 cm by using the pen type type and of the same color which putting a signature done on a different day and time which further scanned signature and any signatures separated by way of cropping using Adobe Photoshop that is stored in the form of jpeg, png or gif to be able to do training and test test testing.

3.2 The Method Of Sample Selection/Sampling

This research will use the data in the form of an image of a signature that will be implemented by using extraction characteristics of Zernike moment and method of Support Vector Machine. Image dataset used is taken from the autograph signature of the original 23 people, each individual taken 9 original signatures, image 6 image taken for training data so that a total of 138 signatures, while the signature image as data testing taken 3 image signatures so the total data signature for tesing is 69 image signature. The signature is then scanned into digital images and stored in the format *. jpeg using the Epson scanner L355 Series.

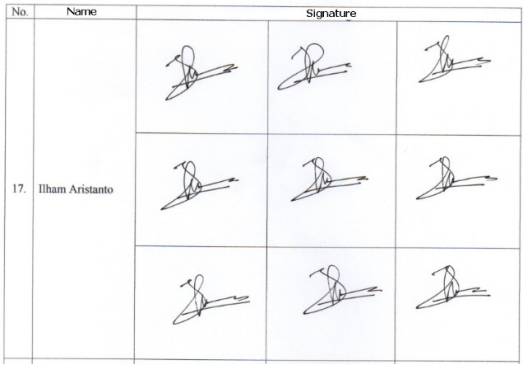

Image 3. Scanned image of a signature.

3.3 The Design Of The Screen

The design of the main menu screen:

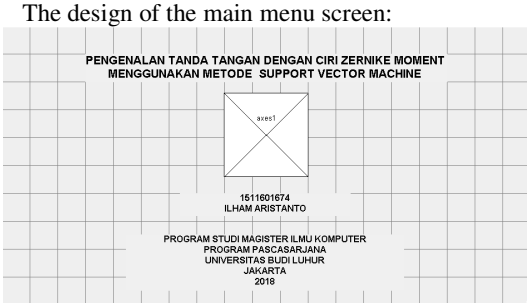

Image 4. Design Of Main Screen.

Recognitionscreen design signature:

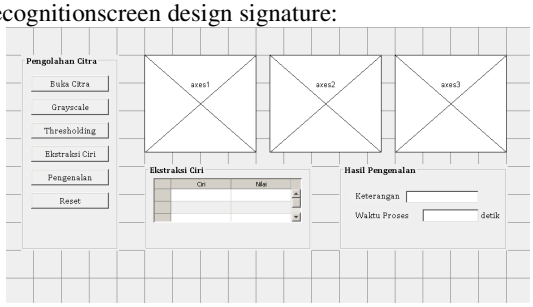

Image 5. Signature RecognitionScreen Design.

4. TRAINING AND TESTING

4.1 Preparation Of Dataset

Datasetthis signature recognition systems using 23 employees put 9 image signature on a sheet of paper is provided in the table measures 4 x 5 cm using a ballpoint pen type type and of the same color. 6 image taken for training data so that a total of 138 signatures, while the signature image as data testing taken 3 image signatures so the total data signature for tesing is 69 image signature. Where the signatutre is done on different days and times, the signature is scanned and each signature is separated by means of capture using Adobe Photoshop that is stored in the form of a jpeg, gif or png to be done test test testing and training.

4.2 Prototype Testing

Testing the prototype in this research is done by using a computer that is already installed MATLAB.

Following is the display of the user interface on the model of the introduction of the signature.

The display of the main screen:

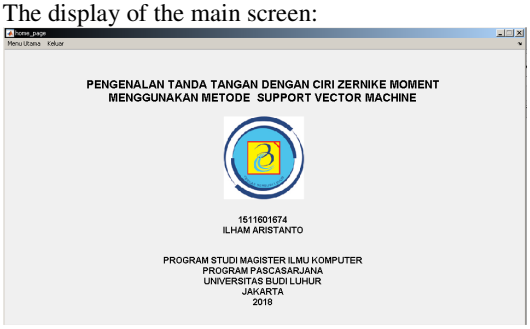

Image 6. Main Display Screen.

The display screen of the recognitionsignature:

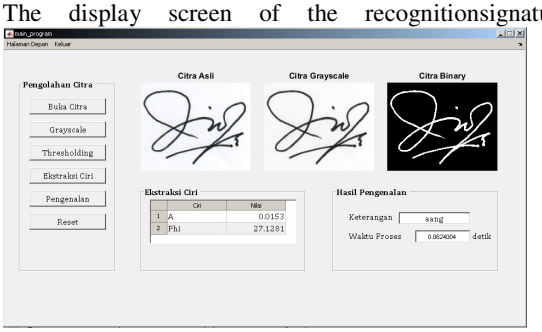

Image 7. The Display Screen Of The RecognitionSignature

Table 1. The Test Results Of The RecognitionSignature

No	Citra Uji	Nilai Ekstraksi	Hasil Pengenalan	Keterangan
1		A : 0.0153 Phi : 27.1281	aang	Pengenalan Benar
		A : 0.0152 Phi : 70.1872	aang	Pengenalan Benar
		A : 0.0161 Phi :24.0004	aang	Pengenalan Benar
23		A : 0.0358 Phi : -7.3545	urniyati	Pengenalan Benar
		A : 0.0238 Phi : -33.4533	deko	Pengenalan Salah
		A : 0.0256 Phi : -18.2130	dede	Pengenalan Salah

Table 2. Results from testing Matrikx Confusion

	Jumlah Seluruh Grid (N)	Hasil Prediksi Klasifikasi																							Total Prediksi
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Klasifikasi Asli	1	3																							3
	2		3																						3
	3			3																					3
	4				3																				3
	5					3																			3
	6	2					1																		3
	7			1				2																	3
	8								3																3
	9			2						1															3
	10										3														3
	11	2										1													3
	12	1	1										1												3
	13			1										2											3
	14														3										3
	15				1											2									3
	16																3								3
	17	1																2							3
	18																		3						3
	19				1												1			1					3
	20																				3				3
	21				2																	1			3
	22		1						1														1		3
	23				1	1																		1	3
Total Aktual		9	5	7	8	4	1	2	4	1	3	1	1	2	3	2	4	2	3	1	3	1	1	1	69

Tabel 3. Value True False Precision and Recall

		Nilai *Precision*	
		TRUE	FALSE
Nilai *Recall*	TRUE	49	20
	FALSE	12	195

Tabel 4. The value results of True False Precision and Recall

Pengenalan	Hasil *Precision* $\frac{TP(n)}{nP(n)}$	Hasil *Recall* $\frac{TP(n)}{nA(n)}$
1	1	0.333333333
2	1	0.6
3	1	0.428571429
4	1	0.375
5	1	0.75
6	0.333333	1
7	0.666667	1
8	1	0.75
9	0.333333	1
10	1	1
11	0.333333	1
12	0.333333	1
13	0.666667	1
14	1	1
15	0.666667	1
16	1	0.75
17	0.666667	1
18	1	1
19	0.333333	1
20	1	1
21	0.333333	1
22	0.333333	1
23	0.333333	1
Persentase	71.01449 %	86.89958592 %

From the results of table 2 shows 69 times the signature image recognition test with the identified results as many as 45 signature images, while those

that do not match the identifier are 24 signature images. Of the 24 signature images that are not in accordance with the identifier, after analyzing the value of feature extraction approaches the extra value of other characteristics that are not the recognition, so the identifier is not in accordance with the original recognition.

$$\text{Accuracy} = \frac{49 + 195}{276} = 0.884057971$$

Obtained valuePrecision 71%, valueRecall 86% and Accuracy 88%.

5. CONCLUSION

Based on the results of the analysis that was done against the issue, problem formulation, system design, and system testing of the research that has been created, it can be drawn some conclusions, among others:

1. Accuracy results from the introduction of the signature level of 88%.
2. Factors of pressure and speed in writing signatures, where when the pressure and speed which is less then the process will not result in the introduction of maximum success and can experience an error resulting in a recognizable signature instead of the signature concerned.
3. The pull factors and the piece with the dataset too far, then the process of recognition will not run properly.

Here is an advice that can be used as material for the consideration of further research:

1. In further research it is necessary to develop an Invariant Moment-based extraction feature method by using the Support Vector Machine method to obtain better accuracy than Zernike Moment feature extraction.
2. There is also on the research findings of the existence of the image is not recognized at all on some image signature to become a new problem on the upcoming research.

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