International Journal Of Science, Engineering, And Information Technology
Vol. 4 Issue. 2, July 2020 - University Of Trunojoyo Madura
ISSN: 2548-4214

International Journal Of Science, Engineering, And Information Technology

Vol.5 Issue.2, July 2021

Address :
Faculty of Engineering
University of Trunojoyo Madura
Jl. Raya Telang PO BOX 2 Kamal, Bangkalan, 69192, East Java, Indonesia
Website : https://journal.trunojoyo.ac.id/ijseit

International journal of science, engineering, and information technology
Volume 05, Issue 02, July 2021
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

Image Classification of Beef and Pork Using Convolutional Neural Network in Keras Framework

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A B S T R A C T

Beef is a food ingredient that has a high selling value. Such high prices make some people manipulate sales in markets or other shopping venues, such as mixing beef and pork. The difference between pork and beef is actually from the color and texture of the meat. However, many people do not understand these differences yet. In addition to socialization related to understanding the differences between the two types of meat, another solution is to create a technology that can recognize and differentiate pork and beef. That is what underlies this research to build a system that can classify the two types of meat. Convolutional Neural Network (CNN) is one of the Deep Learning methods and the development of Artificial Intelligence science that can be applied to classify images. Several regularization techniques include Dropout, L2, and Max-Norm were applied to the model and compared to obtain the best classification results and may predict new data accurately. It has known that the highest accuracy of 97.56% obtained from the CNN model by applying the Dropout technique using 0.7 supported by hyperparameters such as Adam's optimizer, 128 neurons in the fully connected layer, ReLu activation function, and 3 fully connected layers. The reason that also underlies the selection of the model is the low error rate of the model, which is only 0.111.

Keywords: Beef and Pork, Model, Classification, CNN

Article History
Received 07 February 21 Received in revised form 30 March 21 Accepted 23 June 21

1. Introduction

The high selling price of beef has resulted in the presence of some seller to cheat by mixing pork that has a lower selling price with beef. This issue has been going on for several years in Indonesia. Hence, the government must consider the importance of safety and product quality assurance in the market. Food safety and assurance consist of several aspects, such as health, hygiene, and halal labelling [1]. Food products containing pork are strictly prohibited for consumption in countries with a majority Muslim and Jewish population [2].

The difference between pork and beef can be seen mainly in the color and texture. However, there are still many people who do not understand these differences. Nowadays, one of many solutions is to use a technique that might directly identify and distinguish the two types of meat. Image classification is one of the techniques in Deep Learning that can be used in distinguishing the two types of meat.

In the development of the image classification method, Convolutional Neural Network (CNN) has been used by researchers as a deep learning classification method with good performance compared to traditional machine learning methods. Several studies applied the traditional machine learning methods in classifying types of meat have been conducted such as image classification for types of goat, buffalo, cow, and horse meat types using SVM [3], and image classification for types of beef, goat, and pork using KNN [4]. However, as far as the authors knowledge, there is no research on using CNN for meat classification.

One of the framework developed by Google for image classification using CNN is Keras. The advantages of Keras such as the tools are sufficient to build various deep learning algorithm, easy to understand, and work well on simple model construction. The development of CNN began with LeNet architecture built by LeCun [5] in the classification and handwriting recognition of bank accounts. LeNet network is a very simple deep learning network.

The Deep Learning uses experimentally principles in finding the best hyperparameter in various cases. Hence, LeNet architecture may also be inappropriate in certain cases which results in poor performance of the model. The model is also vulnerable to overfitting, that is, the model was able to work well on training data but not for test data [6]. There are several methods of handling overfitting to produce more optimal model performance. Hence, this study aims to find out the best image classification model of pork and beef images by comparing several regularization methods to overcome the symptoms of overfitting.

2. Literature Reviews

2.1 Convolutional Neural Network (CNN)

CNN is an implementation of a more special Artificial Neural Network (ANN) and is considered the best method for image recognition cases. CNN architecture consists of three layers, namely, the convolution layer,

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E-ISSN 2548-4214

the pooling layer, and the fully-connected layer [7]. The following is an architecture of CNN that uses two convolution and pooling layers, and two fully connected layers.

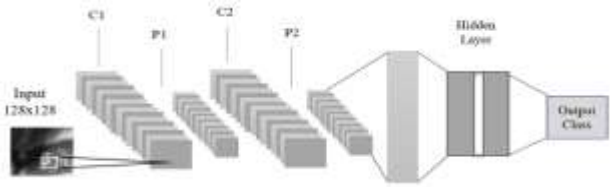


Figure 1. CNN Archiitecture

There are two main components of the CNN method, feature extraction and classifier. The feature extraction is at the convolution layer and the pooling layer, while the classifier is at the fully connected layer. Specific features of an object can be recognized in the feature extraction [8], while the classifier is used for model learning and find the corresponding label for every test image [9].

Every classification case in machine learning is vulnerable to overfitting issues. The implementation of the final CNN model only fits with train data so that it is unable to predict new data. The following is an illustration of overfitting which is showed in the loss classification metric plot.

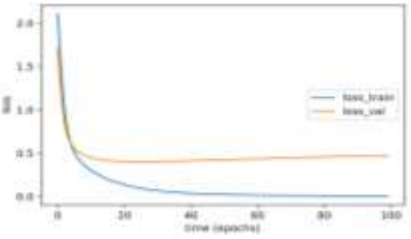


Figure 2. Illustration of Overfitting Shown in the Loss Classification Metric Plot [6]

Figure 2 shows that the loss from the train data decreases and then stabilizes, but the loss from the test data looks consistent away from the loss of train data. Furthermore, the regularization method is usually used in overfit model. There are several regularization methods, namely, dropout, L2, and max-norm.

2.2. Regularization Method

Regularization is one way of obtaining a robust model of the overfitting problem, in principle that limits the complexity of the parameters of the model and reduces the sensitivity of the effect on the training data. The most important concept of regularization is to find only useful features or characteristics and eliminate useless features from a network [10].

1. Dropout

The dropout technique can deal with overfitting [11] and is more effective for networks that use ReLU in the hidden layer. Dropout refers to eliminating neurons that are hidden or visible layers in the network. Each neuron will be given a p probability that is worth between 0 and 1. Dropout values in MLP hidden layers typically range from 0.5 to 0.8 [11].

2. L2

As the L2 regularization of weights, there is a penalty term in the loss function $||w||^2$ and λ is a value determined by the researcher to see how much regularization has occurred and can improve the loss function without regularization. The following is an equation of the new loss function E.

$$E = E + \lambda ||w||^2$$

The main feature of L2 regularization is that makes the weights evenly distributed, so the weight vector is smooth [12].

3. Max-norm

One of the main forms of regularization is by limiting the vector of weights that enter into each layer hidden by constant c. The two previous regularizations are applied by adding a decayed form to the loss function. However, max-norm assigns the role by limiting the weights $|w|$ to always be below a constant value c.

3. Materials and Methods

2.1 Dataset

This study uses image data of beef and pork. The data were obtained from direct observation by taking pictures of the meat using a smartphone camera. The required data is the image of each type of meat (i.e beef and pork). Both types of meat were obtained from a traditional market in Bogor, the Surya Kencana Bogor market. As much as 90% of the data from both types of meat is the result of the shooting of 250 grams of pork and fresh beef tenderloin, which is divided into several pieces.

From several pieces of meat, repeated shots were taken from different angles. While the other 10% of data comes from shooting for meat on the ribs and thighs without separating them into several pieces, but images were still taken repeatedly from different angles.

From the shooting, 3000 image data were obtained for the total of both types of meat. Based on data, the researcher used 15 % of the total as test data. therefore, as many as 2550 data are training data, and 450 other data as test data.

2.2 Analysis Procedure

The data analysis steps carried out in this study are as follows:

1. Preprocessing by resizing the image to 128x128 pixels and changing the color channel to greyscale with the following calculation.

$$G_{Average} = \frac{R+G+B}{3} \quad (1)$$

R, G, and B are the values for each component of the Red, Green, and Blue colors in the image.

2. Partitioning data: 85 % train data; 15 % test data.
3. In the CNN model training process, the following is the process:
   a. Convolution, i.e multiplication between input matrix and filter kernel matrix. The following is the equation in calculating the value of the feature map resulting from the convolution process if given the image $\in \mathbb{R}^{WxH}$, the convolution of the $f \in \mathbb{R}^{PXQ}$ kernel.

$$(\boldsymbol{X} * f)(i,j) = \sum_{m=0}^{P-1} \sum_{n=0}^{Q-1} \boldsymbol{X}(i+m, j+n) f(m,n)\,,$$
$$i = 0,..,H-1, j = 0,..,W-1 \quad (2)$$

Where :
$(\boldsymbol{X} * f)\,(i,j)$ = feature map
$\boldsymbol{X}$ = input matrix

f = kernel matrix
m, n = kernel size
W, H = Width, Height (input size)

b. Activating the results of the convolution layer by applying the non-linear function ReLu to the values in the feature map.

$$g(x) = \max(0, x) \quad (3)$$

If the input is negative, the output of the neuron is expressed as 0. Whereas if the input is positive, then the output of the neuron is the input value itself.

c. Max-pooling to reduce input size.
d. Flattening. Get the last max-pooling result into one vector.
e. Apply backpropagation algorithm learning on the fully connected layer to get the best neurons that will be used in the classifier layer.
f. Apply the sigmoid function to get a probability of the classification result.

$$p(y = 1|x; w) = g(\boldsymbol{w}\boldsymbol{x}^{\boldsymbol{T}}) = \frac{1}{1 + e^{-\boldsymbol{w}\boldsymbol{x}^{\boldsymbol{T}}}} \quad (4)$$

It is known that y is the class, $\boldsymbol{x}$ as the input image, $\boldsymbol{w}$ as weight, and g is the activation symbol of the function.

4. Build a CNN baseline model by inserting the required hyperparameter such as array batch size, optimizer type, number of iterations or epoch, initialization type, kernel filter type, and number of neurons in the fully connected layer.
5. Identifying overfitting.
6. Compare several models with regularization methods that can overcome the overfitting of the models.
   a. The model uses Dropout regularization
   b. The model uses L2 regularization
   c. The model uses Dropout and L2 regularization
   d. The model uses Max-Norm regularization
   e. The model uses Dropout and Max-Norm regularization
   f. The model uses L2 and Max-Norm regularization
   g. The model uses Dropout, L2, and Max-Norm regularization
7. Evaluate the classification results of the baseline model and models at the sixth point.
   A model with high accuracy and small error will be selected as the image classification model of pork and beef. The accuracy, F1-Score, and AUC scores of each model will be compared to get the best results.

4. Result and Discussion

4.1 Baseline Model

The baseline model in this study is a classification model that only uses CNN's main architecture. The following are the classification results using the Baseline model.

Table 1 Confusion matrix of image classification of pork and beef using baseline model

Prediction	Reference	
	Pork	**Beef**
Pork	217	3
Beef	8	222

Table 1 shows the confusion matrix from the results of the classification of pork and beef images using the CNN Baseline model. The value of 217 represents the number of True Positives (TP) which is the amount of data for a positive class namely '0' or pork and is correctly classified as pork. In contrast, the value of 222 represents the number of True Negatives (TN) which is the amount of data for the negative class namely '1' or beef and is correctly classified as beef. Meanwhile, the values 3 and 8 show the number of False Positive and False Negative, respectively.

Figure 3 shows the presence of overfitting symptoms characterized by the greater the epoch the greater the distance between plot loss in the training data and the test data. This may result in the constructed classification model being unable to generalize test data. Overall, the loss value generated by this model is 0.216.

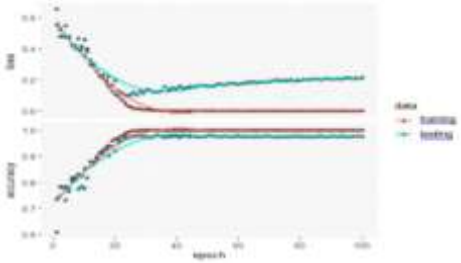


Figure 3. Plot Loss and Accuracy of Baseline Model

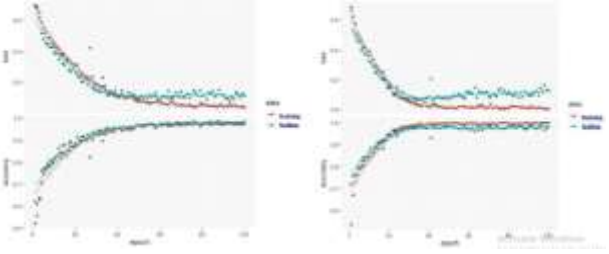
4.2 Summary of Classification Model Performance

This study compared several regularization methods consisting of several values in each method. Based on the results in Table 2, several models can be the best model selection candidates, namely the dropout model (p = 0.5) and the dropout model (p = 0.7). The following is a summary of model performance based on several model comparisons that have been done.

Table 2 Model performance based on comparison of regularization in the models

Regularization			Model Goodness Measure			
Dropout (p)	**L2 (λ)**	**MaxNorm (c)**	**Accuracy**	**Loss**	**AUC**	**F1-Score**
0.5			0.978	0.126	0.996	0.978
0.6			0.973	0.134	0.995	0.974
0.7			0.976	0.111	0.996	0.975
0.8			0.971	0.112	0.996	0.971
	0.001		0.969	0.164	0.989	0.968
	0.005		0.976	0.141	0.993	0.975
	0.01		0.942	0.257	0.989	0.939
	0.05		0.951	0.270	0.987	0.951
		3	0.973	0.136	0.994	0.973
		4	0.971	0.160	0.995	0.971
0.6	0.001		0.967	0.189	0.993	0.966
0.6	0.005		0.964	0.219	0.994	0.965
0.7	0.001		0.960	0.209	0.995	0.959
0.7	0.005		0.962	0.225	0.996	0.961
0.5		3	0.960	0.960	0.991	0.959
0.6		3	0.958	0.958	0.992	0.957
0.7		3	0.971	0.190	0.994	0.971
0.8		3	0.951	0.282	0.987	0.950
	0.001	3	0.971	0.142	0.994	0.972
	0.005	3	0.978	0.138	0.992	0.978
0.7	0.005	3	0.962	0.228	0.992	0.992

Table 2 shows that model dropout (p = 0.7) has the lowest error rate. However, the dropout model (p = 0.5) produced higher accuracy and F1-Score than the dropout model (p = 0.7). Based on Figure 4, the dropout model (p = 0.7) shows a smaller gap between training and test losses than the dropout model (p = 0.5).



(a) **(b)**

Figure 4. Classification Metric Plot, **(a)** Dropout Model ($p = 0.7$); **(b)** Dropout Model ($p = 0.5$)

The lowest error rate and ideal classification metric are the main factors to be achieved in the image classification modeling of pork and beef in this study. This fact is because the model will be able to generalize to new data. Therefore, in this study, the dropout model (p = 0.7) is the best way to classify pork and beef images. The following confusion matrix for the classification result of pork and beef images using the dropout model (p= 0.7).

Table 3 Confusion matrix of image classification of pork and beef using dropout model ($p = 0.7$)

Prediction	Reference	
	Pork	**Beef**
Pork	218	4
Beef	7	221

Table 3 shows that the number of images classified correctly by their class 'pork' and 'beef' is 218 and 221 images, respectively. The model performance can be seen in the 97.6% accuracy obtained from the dropout model (p = 0.7). At the same time, the AUC and F1-Score values of the dropout model (p = 0.7) were 99.96% and 97.5%, respectively. Although the accuracy of the dropout model (p = 0.7) and the benchmark model is not much different from F1-Score, it turns out that the error rate generated is small, 0.111.

5. Conclusion

The best classification result of pork and beef images were obtained from a model that used dropout regularization with $p = 0.7$ because it has the best model goodness measure and was able to overcome the overfitting symptoms that occurred in the baseline model. The CNN structure used is two convolution layers, three fully connected layers with hyperparameters such as Adam optimizer, Glorot Uniform Initializer, ReLu activation function, Max-pooling, and Binary Cross Entropy. Based on the model, from 450 test data, it is known that 218 images of pork were correctly classified and 221 images of beef were correctly classified.

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International journal of science, engineering, and information technology
Volume 05, Issue 02, July 2021
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

Feature Selection and K-nearest Neighbor for Diagnosis Cow Disease

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A B S T R A C T

The large number of cattle population that exists can increase the potential for developing cow disease. Lack of knowledge about various kinds of cattle diseases and their handling solutions is one of the causes of decreasing cow productivity. The aim of this research is to classify cattle disease quickly and accurately to assist cattle breeders in accelerating detection and handling of cattle disease. This study uses K-Nearest Neighbour (KNN) classification method with the F-Score feature selection. The KNN method is used for disease classification based on the distance between training data and test data, while F-Score feature selection is used to reduce the attribute dimensions in order to obtain the relevant attributes. The data set used was data on cattle disease in Madura with a total of 350 data consisting of 21 features and 7 classes. Data were broken down using K-fold Cross Validation using k = 5. Based on the test results, the best accuracy was obtained with the number of features = 18 and KNN (k = 3) which resulted in an accuracy of 94.28571, a recall of 0.942857 and a precision of 0.942857.

Keywords: K-Nearest Neighbor, F-Score, Feature Selection, Cow Disease, multi-class.

Article History
Received 24 February 21 Received in revised form 27 June 21 Accepted 26 July 21

1. Introduction

Cows are a very potential livestock commodity in Bangkalan Madura. The support for general grazing land covering 19,025 hectares and the potential for fodder crops of 54,550 hectares contributed to the development of production for cattle breeders amounting to 663,290 [1]. The need for high beef must be balanced with good quality beef. The quality and safety of beef has several criteria, one of which is safe or does not contain germs [2]. Handling of livestock health is examining sick cattle through examinations and changing the changes that occur in livestock with visible symptoms so that they can be taken from the disease [3]. The lack of knowledge of cattle breeders regarding the various diseases that attack livestock as well as solutions for handling cow disease is one of the reasons for the health management process in cattle [4]. There are several types of existing cattle disease, namely intestinal worms, dystocia and others [3,4]. In the study of cow disease, there are 21 symptoms, namely: fever, dull hair, uneasiness, cough, ear scabs, itching, runny nose, paralysis, thinness, limping, runny nose, weakness, hair loss, skin disorders, difficulty breathing, miscarriage, ulcers, bleeding wounds, decreased appetite, bloody stools. Many diseases in cattle cause farmers difficulty in determining detection. Classification is a process approach used to classify data or disease symptoms based on certain categories [5]. The algorithm used for grouping or classifying cattle disease is the K-Nearest Neighbor (KNN) algorithm. KNN is an algorithm that is easy and flexible in giving problems in using the distance approach [5]. The contribution of this study is the classification of SAPI disease with multi-class feature selection using the f-score-KNN method and z-score for classification.

KNN has been widely used in various fields, including disease diagnosis, determining new student admissions, e-learning recommendations and others. The advantage of the KNN method is that it is superior to noisy training data and is effective for large training data [6]. Research on the performance of the KNN algorithm with Naive Bayes, J48 and the Support Vector Machine to determine the position in the building, with 41 public space locations on the UKDW campus shows that the KNN algorithm is better than using the Naive Bayes algorithm, J48 and Support Vector Machine [6]. The KNN is one of a supervised machine learning algorithm used for classification of objects based on learning data, calculates the k of nearest neighbours in the feature, and a sample of a specific category [7,8, 9]. This algorithm involves several main factors: distance measurement, K-value selection and so on [10,11]. The aim of this study was to classify diseases based on feature selection to obtain high accuracy. Data that has been selected for features will be carried out in the normalization process.

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E-ISSN 2548-4214

Normalization is the process of scaling attribute values over a certain range. The weight value used is more stable and affects the level of accuracy [12]. Several normalization methods are z-score, min-max, and decimal scale. Z-score is the method with the highest accuracy value [13]. Based on previous research, KNN has not been used to classify cows with the characteristics of Pamekasan cattle, and it is implemented by feature selection and normalization with z scores. Select the features that are used to reduce or eliminate the features or symptoms of Cow disease that are less relevant. The study with the title of applying the feature selection method to improve the diagnosis of breast cancer showed that the performance of the C4.5 and Naïve Bayes algorithms improved after using the f-score feature selection [14,15,16]. Therefore, the classification of bovine disease in this study uses the f-score for feature selection, the z-score for normalization, and the KNN for determining the disease diagnosis.

2. Feature Selection

Feature selection is a preprocessing stage that is used to remove features or terms that are less relevant to a data or document [5]. Feature selection reduces features or terms that are less relevant and has no effect on modeling or classification. Feature selection is divided into three categories namely filter models, wrapper models and embedded models [5]. The f-score feature selection is a feature selection model that is included in the filter feature selection model [17]. The technique used in the f-score measures the discrimination of two sets of real numbers. This feature selection can evaluate the features individually. With the training vector X_k, k = 1…, m, if the number of positive and negative n + and n- respectively. Then the f-score of i feature is defined by equation (1):

$$Fi=\frac{(x_i^{(+)}-xi)^2+(x_i^{(-)}-xi)^2}{\frac{1}{n+-1}\sum_{k-1}^{n+}\left(x_{ki}^{(+)}-xi^{(+)}\right)^2+\frac{1}{n_--1}7\sum_{k-1}^{n-}\left(x_{ki}^{(-)}-xi^{(-)}\right)^2} \quad (1)$$

With :

x_i = Average of features to - *i*,
$x_i^{(+)}, x_i^{(-)}$ = Positive and negative dataset
$x_{ki}^{(+)}, x_k^{(+)}$ = The i feature of k-positive case and k-negative case

The numerator shows discrimination between positive and negative sets and the denominator shows the features in the two sets [5]. The f-score feature selection works as a multi-class. In the Cattle disease dataset, there are seven classes. After selecting the f-score feature, the feature that has a greater threshold value is selected and the rest will be reprocessed for other classes. Figure1. This is the feature selection work process flow. The process of this flowchart starts with inputting disease data, calculating the mean and f-score value, input threshold, if the f-score is less than the threshold value, it will remove the feature.

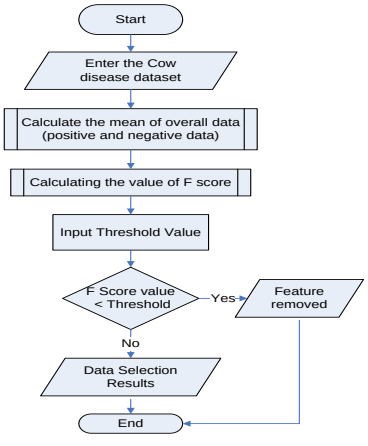

Figure 1.F-Score Feature Selection Flowchart

2.1. K-Nearest Neighbour (KNN)

K-Nearest Neighbor is a supervised learning algorithm, where the results of new query instances are classified based on majority of categories on KNN. The most arising class will be the class resulting from the classification [18]. K-Nearest Neighbor facilitates the training data modeling process until it is needed to classify test data samples. The training data sample is described by a numerical item. When the sample test data is unknown, K-Nearest Neighbor will look for the k training sample closest to the test data sample. In this study, distance measurements will be carried out use Euclidean Distance. The Euclidean Distance formula is presented in equation (2) [12]. The following are steps for calculating KNN in this study are Determining the value of k, Calculating the distance between the test data and the training data, Sorting the distance from smallest to largest, Taking as much data as the nearest k and choosing the major value

$$d_{(xi,xj)} = \sqrt{\sum_{r=1}^{n}(x_{ir} - x_{jr})^2} \quad (2)$$

With :

$d(xi,xj)$ = Euclidean Distance
n = Data dimension
x_i = Test Data
x_j = Training Data

2.2. Cross Validation

Cross Validation is a method that can be used for system testing [19]. Cross Validation processes data by dividing the data used into two parts. The first part is used as training data and the second is used as testing data. In general, the k value test was carried out 5 times [20]. K-fold cross validation can be seen in Figure 2

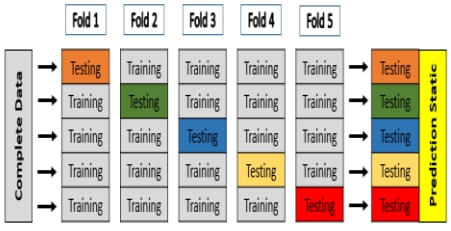

Figure2. *Cross Validation* Model

3. System Design

The system design model is the stages of the data processing process to the output in the form of a disease diagnosis. The system design model is shown in Figure 3.

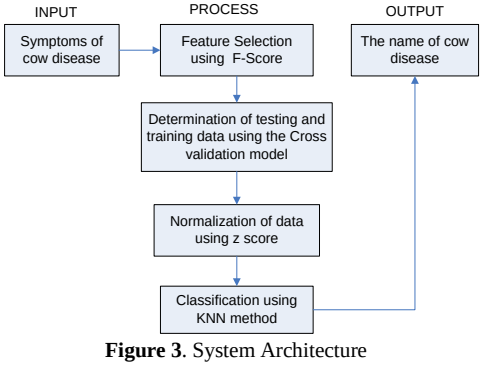

Figure 3. System Architecture

Base on Figure 3. The system architecture consists of three stages, namely input, in the form of symptoms of cow disease. The process consists of feature selection using the F-score method, then testing the system data with k-fold cross validation, by determining the training data and test data. After this process, normalization is carried out using the Z-Score method, and determining the output in the form of the name of the disease using KNN algorithm. The data needed in this study are cow disease data and cow disease symptoms which are used as training data and test data. Data on the name of cow disease are Bovine Ephemeral Fever (BFE), Cacingan, Scabies, Malignant Catarrhal Fever, Infectious Bovine Rhinotracheitis (IBR), Miasis, Septicemia epizootica. Data on symptoms or features of cow disease are Fever (F1), Dull Hair (F2), Uneasy (F3), Cough (F4), Ear Scab (F15), Itching (F6), Nasal Mucus (F7), Lame (F8), Thinness (F9), Limp (F10), Runny Nose (F11), Diarrhea (F12), Weakness (F13), Hair Loss (F14), Skin Disorders (F15), Difficulty Breathing (F16), Miscarriage (F17), Ulcers (F18), Blood Sores (F19), Decreased Appetite / Anorexia (F20), Bloody Stool (F21). The process of classification of cow disease is shown in Figure 4. Feature Selection Form. Based on the figure, there are 3 stages, namely loading a dataset of bovine symptoms and diseases, then selecting features, the classification process and implementation based on the best accuracy of the disease classification process.

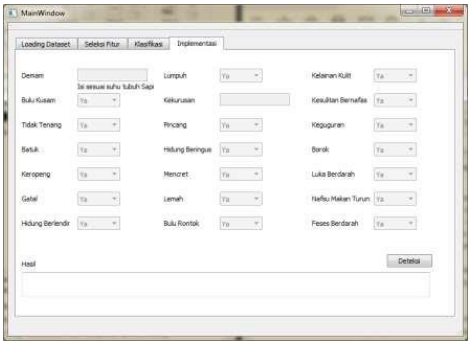

Figure 4. Form for Classification Process

4. Testing and Analysis

Cow disease data used is from District Livestock Service Office Bangkalan. The data obtained total are 350 data, consisting of 21 features as symptoms of disease and 7 classes as name of the disease. Furthermore, the F-Score feature selection is carried out by calculating the relevant or irrelevant features, in this process it is obtained from the ranking of each feature. Data that has been selected for features is divided using K-fold Cross Validation into 5 parts consisting of 1 part of the test data and 4 other parts as training data and applied to each data segment. Furthermore, training data and test data are carried out by normalizing the Z-Score so that the range of values between features is not too far away. Furthermore, KNN calculation is carried out between the training data and the test data, so that the label is obtained from the test data. After completion, it is necessary to evaluate using the Confusion Matrix which results in accuracy, recall and precision. In this study, experiments were carried out without feature selection (Trial Scenario 1) and with feature selection (Trial Scenario 2).

4.1. Trial Scenario 1

This test was carried out using K-Nearest Neighbor with different k values, namely (3, 5, 7, 9, 11) and 21 features. The trial using without this feature selection is shown in Table 1.

Table 1. Trial Scenario Results 1

K	21 Features		
	Accuracy	***Recall***	***Precision***
3	14.512	27.576	27.714
5	13.528	27.316	27.429
7	14.319	25.818	25.429
9	12.925	25.798	25.714
11	14.674	28.571	28.571
Average	13.992	27.016	26.971

Table I. Shows that the highest accuracy without feature selection is at K-fold Cross Validation located at K-Nearest Neighbor (k = 11), which is 14.67393, a recall of 28.57142 and a precision of 26.97143.

4.2. Trial Scenario 2

This test uses K-Nearest Neighbor with a selection of f-score features and number of features 20,19,18,15,13,10,7,5 with different k values, namely 3, 5, 7, 9, 11. Table 2 using 20 features selection. Trials using this feature selection are shown in Table 2 toTable 10.

Table 2. Trial Scenario Results 2

K	20 features		
	Accuracy	**Recall**	**Precision**
3	81.710	75.654	74.286
5	85.862	85.504	84.571
7	87.814	87.863	86.571
9	89.887	87.186	86.000
11	90.354	88.004	87.429
Average	87.125	87.125	83.771

Table 2. Shows the results of 20 feature selection trial, with the highest accuracy at K = 11. The accuracy result for K-11 is 90,354, recall is 88,004 and precision is 87,429.

Table 3. Trial Scenario Results 3

K	19 Features		
	Accuracy	**Recall**	**Precision**
3	82.034	76.895	75.143
5	85.461	85.387	84.286
7	91.108	89.063	88.857
9	92.177	91.077	90.857
11	91.618	90.120	90.000
Average	88.480	86.508	85.829

Table 3. Shows the results of 19 feature selection trial, with the highest accuracy at K = 9. The accuracy result for K-9 is 91.177, recall is 91.077 and precision is 90.857.

Table 4. Trial Scenario Results 4

K	18 Features		
	Accuracy	***Recall***	***Precision***
3	91.714	0.917	0.917
5	90.612	90.977	90.857
7	92.112	90.989	91.143
9	91.867	90.035	90.000
11	91.430	89.413	89.143
Average	91.547	72.466	72.412

Table 4. Shows the results of 18 feature selection trial, with the highest accuracy at K = 7. The accuracy result for K-7 is 92.112, recall is 90.989 and precision is 91.143.

Table 5. Trial Scenario Results 5

	15 Features		
K	**Accuracy**	***Recall***	***Precision***
3	74.447	70.876	68.571
5	76.347	73.258	71.143
7	74.337	73.039	71.143
9	68.559	72.868	71.143
11	67.851	70.032	68.286
Average	72.308	72.014	70.057

Table 5. Shows the results of 15 features selection trial, with the highest accuracy at K = 3. The accuracy result for K-3 is 74.447, recall is 70.876 and precision is 68.571.

Table 6. Trial Scenario Results 6

	13 Features		
K	**Accuracy**	***Recall***	***Precision***
3	63.556	63.398	62.571
5	63.081	61.574	60.571
7	57.238	60.706	59.143
9	51.300	59.875	58.286
11	50.847	58.695	57.429
Avera	57.204	60.850	59.600

Table 6. Shows the results of 13 features selection trial, with the highest accuracy at K = 3. The accuracy result for K-3 is 63.556, recall is 63.398 and precision is 62.571.

Table 7. Trial Scenario Results 7

	10 Features		
K	**Accuracy**	***Recall***	***Precision***
3	51.906	59.396	58.000
5	64.483	60.348	58.571
7	45.181	58.385	45.181
9	38.945	57.103	55.143
11	37.938	56.173	54.000
Average	47.691	58.281	54.179

Table 7. Shows the results of 10 features selection trial, with the highest accuracy at K = 5. The accuracy result for K-5 is 64.483, recall is 60.348 and precision is 58.571

Table 8. Trial Scenario Results 8

	7 Features		
K	**Accuracy**	***Recall***	***Precision***
3	34.990	48.512	46.857
5	34.604	46.925	45.143
7	25.415	40.956	40.571
9	23.693	38.569	38.000
11	22.420	37.379	36.571
Average	28.225	42.468	41.429

Table 8. Shows the results of 7 features selection trial, with the highest accuracy at K = 3. The accuracy result for K-3 is 34.990, recall is 48.512 and precision is 46.857

Table 9. Trial Scenario Results 9

	5 Features		
K	**Accuracy**	***Recall***	***Precision***
3	32.758	42.455	40.000
5	35.450	43.407	40.571
7	32.271	42.836	40.000
9	24.896	40.448	37.429
11	23.602	39.258	36.000
Average	29.795	41.681	38.800

Table 9. Shows the results of 5 features selection trial, with the highest accuracy at K = 5. The accuracy result for K-5 is 35.450, recall is 43.407 and precision is 40.571

Table 10. Trial Scenario Results 10

Number of	**Experiment Results**		
Features (K)	**Accuracy**	***Recall***	***Precision***
20	90.354	88.004	87.429
19	92.177	91.077	90.857
18	92.112	90.989	91.143
15	74.447	70.876	68.571
13	63.556	63.398	62.571
10	64.483	60.348	58.571
7	34.990	48.512	46.857
5	35.450	43.407	40.571

Table 10. Show the results of the feature selection trial were 20,19,18,15,13,10,7,5, the highest accuracy was at K-Nearest Neighbor (k = 19) which was 92,177, recall was 91,077 and precision was 92,177.

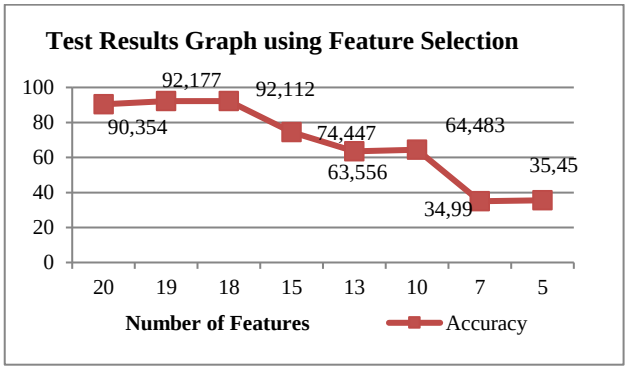

Figure 7. Graph of Feature selection accuracy results

Based on Figure 7. shows that the feature selection with K = 19 has the highest accuracy, namely 92.177, so that this rule is used as a classification of cow disease

Table 11. Comparison Trial Results

Scenario	Experiment Results		
	Accuracy	***Recall***	***Precision***
No Feature	14.674	28.571	28.571
Feature Selection	92.177	91.077	90.857

Table 11 is the comparison result of the test scenario 1 and test scenario 2 using the K-fold Cross Validation (k = 5). In the 1st trial scenario, the application of the K-Nearest Neighbor model without using feature selection resulted in an accuracy of 14.67393, a recall of 28.57142 and a precision of 28.57142. Whereas in the second trial of the K-Nearest Neighbor classification model using feature selection that produces the highest accuracy with the number of features = 19 and K-Nearest Neighbor (k = 5) which is equal to 92.17703, recall of 91.07744 and precision of 90.85714

5. Conclusion

Based on the research results, it can be concluded that the comparisons without feature selection and using feature selection are higher than feature selection. The selection of features with the highest accuracy is found in feature = 19, K-Nearest Neighbor (k = 5) and K-fold Cross Validation (k = 5), so the rules for this feature selection can be used to determine the diagnosis of cow disease.

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International journal of science, engineering, and information technology
Volume 05, Issue 02, July 2021
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

Effect of Dredging Rate, Sintering Time, Cooling Media on Corrosion Results of Carbon Steel Dredging

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A B S T R A C T

Metal reinforcement that has an impact on improving mechanical properties can occur in various ways, including by strain hardening mechanisms, solid solutions, second phase, prespitations, disperse, grain refinement and texture. In recent years, another method has been developed to obtain good mechanical properties without adding alloy elements, namely by the method of comprehensive plastic deformation (Severe Plastic Deformation). The purpose of this research is to conduct a study of rolling using medium carbon steel with a treatment temperature above recrystallization, rolling rate, sintering time, cooling media as an effort to develop and design new innovations about steel structures being rolled. The study of developing rolling techniques that can be applied in industry and can be applied as learning material / media in higher education requires structured research stages. The best impact value from this temper process is a temperature of 550 ° C for 1 hour where the impact value is 1.58 J / mm² with air conditioning media. In the rolling process above the recrystallization temperature 800 ° C deformation 20% the impact value is 1.7 J / mm² where the toughness indicates a ductile fracture while the deformation is 10% the impact value

Keywords: Cooling Media, Corrosion Results, Dredging Dredging rate, Sintering Time.

Article History
Received 08 December 19 Received in revised form 07 February 20 Accepted 26 July 21

1. Introduction

The development of material technology and microtechnology engineering has driven enormous changes in the use of materials, especially steel in the industrial world. Along with the development, steel is needed with the characteristics and characteristics that are appropriate to the conditions when applied [1]. Therefore we need steel with strong characteristics, tough and corrosion resistant [2]. The toughness which is still low on a steel will cause easy breakage and easy corrosion. In recent years, another method has been developed to obtain good mechanical properties without adding alloy elements, namely by the method thorough plastic deformation (Severe Plastic Devormation). The overall deformation process is the process of forming metals in which the plastic strain given to the metal or material is very large so that it produces fine grain (Ultra Fine Grain). A research, [3] obeseved about Intermittent drying of paddy rice is fully investigated both theoretically and experimentally. A model was developed to represent simultaneous heat and mass transfer for drying stages and mass transfer for tempering one. And both specimen was cylindrical and spherical coordinates assuming non-constant paddy rice physical properties. Further, a set of experiments are designed and carried out in a lab-scale fluidized bed dryer to estimate the moisture diffusivity of rice and to evaluate the effects of different parameters. The model estimates show good agreement with experimental data. Cylindrical model slightly better fits the experimental results specially after tempering stage. Simulation results reveal that thermal equilibrium is rapidly reached within the first two minutes. Air velocity shows to have no significant effect on drying rate when fluidization condition is prevailed. In addition, drying rate is drastically improved after applying tempering stages as a result of moisture gradient removal.

The deformation process is done, among others, can be done by way of the hot working or cold. The deformation process by way of rolling give effect to the violence prevalent in steel. According to [4] rolling process above the recrystallization temperature from the results of the hardness and toughness test at a temperature of 800 ° C deformation of 20% its value above the raw material (raw material), namely a hardness value of 420 BHN and a toughness of 1.7 J / mm² so that it can be concluded that the effect of the rolling process is above the recrystallization temperature at a temperature of 800 ° C deformation 20% better than the initial material (raw material). The research explained that the rolling process and the temperature above the crystallization temperature had an increase in the hardness characteristics of the metal because the structure of the metal grains was getting smaller. But on the other hand the advantages of rolling process results have their own weaknesses against corrosion resistance,

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E-ISSN 2548-4214

such as the results of research conducted by explaining that the corrosion rate of rolling results against NaCl decreases with increasing deformation but it cannot be concluded that grain size affects the rate corrosion due to polarization testing only measures the rate of surface corrosion. From the results of these studies indicate that increasing deformation and structural changes of steel experience a low corrosion rate. [5] research results of the rolling process above the recrystallization temperature from the results of the hardness and toughness test at a temperature of 800 ° C deformation of 20% value above the raw material (raw material), namely a hardness value of 420 BHN and a toughness of 1 , 7 J / mm² so that it can be concluded that the effect of the rolling process above the recrystallization temperature at a temperature of 800 ° C deformation is 20% better than the initial material (raw material) [6]. The rate of corrosion of NaCl decreases with increasing deformation but it cannot be concluded that grain size affects the rate of corrosion because polarization testing only measures surface corrosion rates. A reaseach observed about grain boundary on Fe-Mn-Al-C-Cr annealed steel at 1100 °C for 30 min after hot rolling with 66% and 80% reduction. The fractions of low-Σ coincidence site lattice (CSL) boundaries have exceeded 60% after hot rolling, and reached 77% after annealing treatment. Whether after hot rolling or annealing, the fractions of Σ9 and Σ27 in samples with 80% reduction were obviously higher than those with 66% reduction. It indicated that hot rolling reduction was the key to realize grain boundary character distribution optimization [7] [8], [9]. On this research the effect of rolling treatment under recrystallization temperature that has been done, after the optimal values are taken, the results obtained are still below the raw material (raw material), so it can be concluded that the effect of rolling under recrystallization temperature is only decrease its mechanical properties. According to this reserch tempering can reduce the value of violence and tensile strength. [10] The results of hardness testing on 8 mm thick steel plates show the smaller the diameter of the rolling the higher the price of hardness, the highest hardness price is in the tensile radius of 1000 mm that is equal to 225.5 kglmm^2, and the lowest hardness price is in the area tensile material of 208.4 kg / mm^2. Explanation from some of the above studies, the researchers concluded with a deformation level, and crystallization temperature produces a low corrosion rate[11]. So the researchers took the existing problems to do further research with the aim to produce strength that is tough and high corrosion rate. To produce in accordance with the objectives of the study, researchers conducted tests with sintering time and air conditioning media [2].

The purpose of this research is to conduct a steel rolling study medium carbon with a treatment temperature above recrystallization, rolling rate, sintering time, cooling medium as an effort to develop and design new innovations about steel structures being rolled [12]. The purpose of this research is to conduct a study of rolling using medium carbon steel with a treatment temperature above recrystallization, rolling rate, sintering time, cooling media as an effort to develop and design new innovations about steel structures being rolled undergoing the rolling process with treatment of rolling rate, sintering time and air conditioning media [13]. The purpose of the urgency of the research is that the pursuit of this research is carried out because of the urgent need to find a solution to the problem is that steel is widely used in various needs in the development of technology in various fields [14]. By far the most visible requirement is the need for manufacturing technology such as: manufacturing vehicle equipment, etc. So that the steel users have the results of rolling hoops have characteristics that match the needs such as resistance to corrosion, the level of hardness [15]. The target to be achieved is to find new breakthroughs by utilizing the characteristics contained in steel with a variety of treatments to get maximum results. One of the heat treatment processes in steel is hardening, which is the process of heating the steel to temperatures in the area or above the critical area followed by rapid cooling called quench [16]. The second is the method of comprehensive plastic deformation (Severe Plastic Deformation). The overall plastic deformation process is the process of forming metals in which plastic strain which is given to the metal or material being processed is very large so as to produce a smooth grain (ultra fine grain) [17]. The deformation process is done, among others, can be done by way of the hot working or cold. With some of the above treatment for cooling media using air whose main purpose is to produce deformed steel to resist corrosion [18].

1.1. Bumping

Scraping is the process of flexing the material using plastic properties [19]. The main purpose of the flexing process is to form a plate or the formation of a workpiece with the desired diameter / radius of a certain curvature. To produce a cylindrical or conical construction (for example a boiler, tank, pipe), or structure, a round plate bending machine is needed [20]. This machine consists of three rollers with the same diameter. Two of them are fixed and the other one can be set. Metal plates come in between the three rollers, and flexing occurs. The final diameter can be adjusted by adjusting the third roller: the closer it is to the fixed roller, the smaller the final diameter, the bending of the plate can be in the shape of a circular cone round in the gap between them. Movement on a small flexing machine is done by hand, whereas it is large with a motor[21], [22].

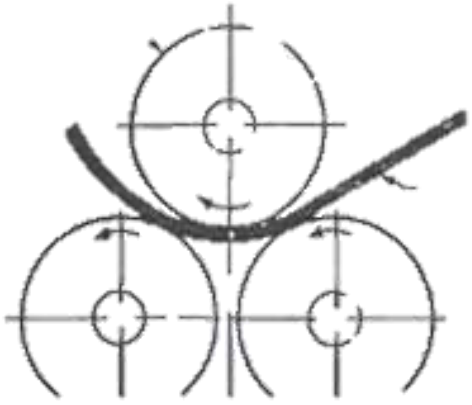

Figure 1. Caption Centered

1.2. Mechanical Properties of Steel

Some important mechanical properties, among others (Zainuri, 2008: 102):

1. Strength (Strength)
   State the material's ability to accept stress without causing the material to break. This strength is of several kinds depending on the type of load at work, namely tensile strength, compressive strength, shear strength, torsional strength and flexural strength.
2. Hardeness
   It can be defined as the ability of a material to withstand scratches, abrasion (abrasion), and identification (penetration). This property is related to wear resistance. Violence also has a correlation with strength.
3. Ductility
   State the ability of the material to accept stress without causing permanent deformation after the threshold is removed. The elasticity also states how much elastic deformation can occur before permanent deformation begins, in other words resilience states the ability of the material to return to its original shape and size after receiving a load that causes deformation.
4. Stiffness
   Stating the ability of materials to accept stress or load without causing deformation or deflection.

1.3. Deformation Process

The effect of temperature on the processes of formation is change material properties and behavior. In general, an increase in temperature will result in a decrease in the strength of the material, an increase in ductility and a decrease in the rate of strain hardening in which the change results in material ease of deformation. Based on the temperature of the material at the time of this deformation, the metal forming process can be classified into two major groups, namely : Hot working, and Cold working[23].

1.4. Sintering Process

Sintering is a heating process below the melting point in order form a new crystalline phase as desired and aim to help react the constituent materials both ceramic and metal materials [24]. The sintering process will have a considerable effect on the formation of the crystalline phase of the material. The phase fraction formed generally depends on the sintering time and or temperature. The greater the sintering temperature it is possible the faster the crystal formation process [25]. The size of the temperature also affects the shape and size of the gap and also affects the structure of crystal growth[26]. Sintering temperatures can be determined from thermal experiments such as DTA, DTG, and DSC. Based on the results of this experiment obtained melt temperature other than decomposition temperature. Each composition of certain compounds has a melting point. Sintering of ceramic materials is usually determined around 75% of the total melting point [27]. In the sintering process, a new phase formation process takes place through a heating process where during the reaction the forming component is still in the solid form of the powder mixture. It is intended that the grains (grains) in adjacent particles can react and bind. The solid phase sintering process is divided into three solids, namely:

1. Early stage
   At this initial stage atomic bonds are formed. Contact between particles forms a neck that grows into grain boundaries between particles. Growth will become faster with an increase in sintering temperature. At this stage shrinkage also occurs due to smooth porosity surfaces.
2. Intermediate stage
   At this stage, particle desification and growth occur, ie small grains dissolve and join large grains. Accommodation of this grain shape results in compaction the better one. At this stage the porosity removal is also carried out. As a result of the grain boundary shift, porosity begins to interconnect and form a cylinder on the side of the grain.
3. The final stage
   The phenomenon of desification and grain growth continues at a slower rate than before. Likewise with the porosity removal process, grain boundary shifts continue. If the grain boundary shift is slower than porosity, the porosity will appear on the surface and are interconnected. However, if the grain boundary shift is faster than porosity, the porosity will precipitate in the product and will be difficult to remove. The resulting product is expected to have a high density and homogeneous, then the homogenization process must occur in the sintering process. If there is an oxide layer on the metal powder, the expected sintering process can be slower. In addition to this oxide layer, the resulting product becomes more brittle, the oxide layer also inhibits the diffusion process between powder particles during sintering and increases the sintering temperature. The oxide layer attached to the powder is formed due to contact between the surface of the powder with air and due to the treatment received by the powder during the powder metallurgical production process. Oxides in powders can be minimized by flowing reduction gases before or during sintering.

1.5. Observation of Micro Structure

Microstructure observation aims to determine changes in microstructure from the material both before and after undergoing heat treatment. The structure, hardness and ongoing transformation of the HAZ (Heat Affected Zone) area can be read immediately on a diagram of a continuous cooling transformation or a CCT (Continuous Colling Transformation) diagram When the steel has cooled to the point "a" (± 6800C), the ferrite will begin to be deposited from austenite. This transformation continues and only ends when the point "b" (± 5900C) is reached and then replaced by the pearlit deposition transformation which will end at point "c" (± 5200C). From the discussion above it can be analyzed that after cooling the structure formed is ferrite and pearlite[28].

Usually a continuous cooling transformation diagram shows also the hardness that steel will have after it cools following a certain thermal cycle. Measuring the cooling time from 8000C to 5000C and combining with the CCT diagram of the same steel, the structure and hardness of the steel in the HAZ area can be determined. The diagram of the continuous cooling transformation can change due to changes in the maximum temperature that occurs[29]. Generally when the maximum temperature rises, curves that indicate the occurrence of certain structures

in the diagram move to the right that lead to the stabilization of martensite formation, if this happens it is clear that the heat treatment results become harder[30].

A research observed about the tensile and fatigue tests were conducted on precipitate strengthened Cu-Ni-Si alloy. The fatigue properties of specimens with cold working and without cold working in air, as well as that of the specimen with cold working in salt atmosphere were investigated. The results show that the monotonic tensile strength and the yield strength are improved obviously, while the elongation decreases by cold working. All the fatigue cracks initiate from the specimen surface by slip deformation. In air condition, the specimens with cold working show shear mode fracture with transgranular crack propagation and it is caused by the obvious texture, while that without cold working show normal mode fracture with both transgranular and intergranular crack propagation. However, in salt atmosphere condition, the specimens with cold working show normal mode fracture with totally intergranular crack propagation[30].

2. Methods

The research method used is an experimental method. Samples to be treated are selected according to materials that are widely used in industry. The material used in this study is medium carbon steel. The material is then heated to a recrystallization temperature by rolling. The specimen consisted of 5 specimens with a thickness of 4cm with a length of 15cm. the workpiece is heated with a temperature of recrystallization with a temperature of 700 C, then cooled with free air and thickness of the deformation of 5%, 10%, 15%, 20%, 25%. In addition, raw materials which were not treated were prepared to compare the results before treatment and after rolling. After that, the micro structure test, the level of corrosivity, are carried out. The specimen will pass the microstructure test, hardness test and tensile test. The results of this study are expected to be used as a guide in the rolling process in order to produce maximum violence.

The equipment used during this research are:

- Furnace Heating (Furnace Naber)
- Thermocouple Type-K
- Hardener
- Calibration term
- Clamp specimen
- Polisher Optical microscope
- VB Microscope
- Brinell hardness test equipment
- Machine Scrap
- Torsee Type AMU10 tensile testing machine

The materials used in this study are as follows:

- Medium carbon steel which is a material used as a car rear spring (leaf spring) which is applied to the palm harvester's blade.
- Resin and hardener.
- Sand paper with grades 120, 240, 400, 600, 800, 1000, 1200 and 1500.
- Digital etching solution 5%
- Panel Fabric

3. Result

Based on the results of hardness testing that the hardness with the most optimal value occurs at a temperature of 700 0 C with a deformation rate of 20% which is 405 on the BHN scale, followed at 550 ° C for 1.5 hours with water cooling media which is 333 BHN and at a temperature of 550 ° C for 1.5 hours with ice water cooling media, and then up to the lowest hardness value of 288.6 BHN at 600 ° C with 5% deformation. Based on the results of the toughness test, it can be seen that toughness with the most optimal value occurs at 605 C with the deformation rate of 5% is 2.36 J / mm², followed by deformation at a temperature of 655 ° C with a deformation rate of 10% which is equal to 2, 4 J / mm² and subsequently to the lowest toughness value of 1.3 J / mm² at 750 ° C with 20% deformation.

4. Conclusion

The conclusions that can be drawn from this study are:

The toughness and shape of the medium carbon steel fracture obtained from the impact test results, namely:

- In the process of forging 550 ° C for 1 hour the impact value is 1 , 39 J / mm² and for 2 hours the impact value is 1.45 J / mm² with ice water cooling media whose toughness shows brittle fracture, while the temperature of 550 ° C during 1 hour the impact value is 1.58J / mm² with the air conditioning medium whose toughness shows a ductile fracture. The best impact value from this temper process is a temperature of 550 ° C for 1 hour where the impact value is 1.58 J / mm² with air conditioning media.
- In the process of rolling under recrystallization temperature 650 ° C deformation 10% the impact value is 2.13 J / mm² and 5% deformation the impact value is 2.3 J / mm² while the temperature 600 ° C deformation 5% the impact value is 2, 37 J / mm² which shows that all toughness is a ductile fracture. The best impact value of the rolling process under this recrystallization temperature is 600 ° C 5% deformation where the impact value is 2.37 J / mm².
- In the rolling process above the recrystallization temperature 800 ° C deformation 20% the impact value is 1.7 J / mm² where the toughness indicates a ductile fracture while the deformation is 10% the impact value.

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International journal of science, engineering, and information technology
Volume 05, Issue 02, July 2021
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

Network Security Analysis and Bandwidth Management

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A B S T R A C T

Computer network users have to spend a lot of money to use the Internet. The Internet has given a very big change in the dissemination of information, so that many people are using data through the Internet. This problem can be solved by MikroTik as a regulator of Internet data traffic and limiting bandwidth that can interfere with computer network activities in accordance with the regulations that have been applied. As a result of not being limited in bandwidth, it causes an overload on a network which has an impact on disrupting internet traffic on that network. Each agency should implement bandwidth restrictions according to the needs of users using the internet. Result from this research is not being limited in bandwidth, it causes an overload on a network which has an impact on disrupting internet traffic on that network. Each agency should implement bandwidth restrictions according to the needs of users using the internet.

Keywords: Data, Database, SQL Injection, Vulnerability.

Article History
Received 19 January 20 Received in revised form 07 February 20 Accepted 26 July 21

1. Introduction

Computer networks are not new at this time. Almost every company has a computer network that facilitates the flow of information within the company. The internet that is becoming popular today is a giant computer network which is a computer network that is interconnected and can interact with each other [1].

This is due to the rapid development of technology, so that in just a few years the number of internet network users has doubled.

If an agency has a bandwidth of about 10 Mb, so that the bandwidth it has can be used properly, each staff section is limited according to the required needs [2]. To overcome the problems that occur, it is necessary to build a bandwidth management system and network security system.

Other research related to the research conducted, namely the Enhancement of E-GSM Channel Capacity with Function Diversion of 3G to 2G Frequency [3], which explained that The main observation of this research is the installation and analysis of frequency function switching from 3G to 2G networks to increase channel capacity. The 850 MHz frequency which was previously owned by Telkom Flexi, was later transferred to Smartfren and will be transferred to 2G GSM operated by Telkomsel Madura. The results showed that the frequency function transfer process went well. This results in the average value of the drive test before diversion is Rx Level = 87.969%, Rx Qual = 87.791%, SQI = 80.809%. The average value of the drive test after diversion is Rx Level = 91.967%, Rx Qual = 89.926%, SQI = 82.049%. The traffic value before the diversion is 503,296 Erlang and 627 Erlang for after the diversion. While the blocking before the transfer was 24.36% and the blocking after the transfer was 1.6%.

one of the other articles is about the Implementation of RC4 Cryptography Algorithm for Data File Security [4], where in the article it is discussed about Communication in the digital era which plays an important role, one can carry out various transactions or exchange data practically and quickly. So that it poses a big risk to information security, ranging from abuse of unauthorized access or authority, modification, information change, destruction to theft, this is in accordance with the main principles of data and information security ranging from Confidentiality, Integrity, Authentication, and Availability. In research that has been carried out using the RC4 Cryptographic Algorithm for Encryption and Decryption of Data Files, it shows that the RC4 algorithm can run well and is able to secure the authenticity of the data so that it is not easily changed by irresponsible people or irresponsible people. does not have access rights either in the form of text or files in several file formats pdf, doc, Docx, Xls, xlsx or text and directly affects the execution time of encrypted and decrypted files.

other related research, discusses the Mobile Phone Application For Someone Fitness Monitoring With Fast Fourier Transform Algorithm [5], in which the research explains The development of science and technology besides facilitating human life in various daily activities. These conditions will cause the body to not fit and the emergence of various health problems. Heart rate is one of the parameters that are useful for providing medical information. Heart rate measurement is very important in the medical world and is one of the standards for knowing one's fitness level. ECG is a medical test to detect abnormalities by measuring the electrical activity produced by the heart. ECG recordings are used to determine the condition of a person's fitness level. Heart rate monitoring can be done using Arduino Uno, AD8232, and Pulse Sensor. The results of heartbeat delivery can be seen

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E-ISSN 2548-4214

through the Android application that was created. A person's fitness level data is sent via DataBase which is then forwarded to the Android application. The value range of a person's fitness level is 49-85 BPM for the male category, while for women with a range of values from 54 to 89 BPM. The error value of detection of a person's fitness level with Sensor Pulse and manual is 2.043%, the sensitivity value is 97.63%, the specificity value is 5.82%, and the accuracy value is 50.35%. In addition, ECG waves are also sent to Matlab for extraction using the FFT algorithm.

other related research, discusses Combination Deep Belief Networks And Shallow Classifier For Sleep Stage Classification [6], which in this research describes In this research, it is proposed to use Deep Belief Networks (DBN) in shallow classifier for the automatic sleep stage classification. The automatic classification is required to minimize the evaluation of Polysomnography because it needs more than two days for analysis manually. Thus the automatically mechanism is required. The Shallow classifier used in this research includes Naïve Bayes (NB), Bayesian Networks (BN), Decision Tree (DT), Support Vector Machines (SVM), and K-Nearest Neighbor (KNN). The analysis compared each method in shallow classifier before and after the classifier were combined with DBN. The results shown that many combination by using the shallow classifiers and DBN had increased. The experiments that have been done indicated a significant increase of Naive Bayes after being combined with DBN. The high-level features generated by DBN are proven to be useful in helping Naive Bayes' performance. On the other hand, the combination of KNN with DBN shows a decrease because high-level features of DBN make it harder to find neighbors that optimize the performance of KNN.

2. Literature Review

The frequent occurrence of abuse of internet access results in downs on a network which results in slow internet access in an agency which can result in losses to the agency [2].

An agency may not apply bandwidth restrictions resulting in slow internet access even though it uses a large bandwidth capacity from an ISP.

A. Mikrotik

MikroTik uses Linux as its operating system. It is used as a network router. It was created to provide comfort and freedom to its users. Administrative settings can be done using Windows Applications; it's called "WinBox". The computer that will be used as a MikroTik router also does not require high specifications [7][2].

For example, only as a gateway. Unless it is used for complex networks, it must use adequate specifications [2]. MikroTik features include Firewall & Nat, Hotspot, Routing, Bandwidth Limiter, DNS server, Point to Point Tunneling Protocol, Hotspot, DHCP server, and many more [8].

Related research, regarding Performance Analysis Of Umts Networks As Reference Of Signal Interference Handling [9], where there is explained A network, not apart from the existence of the maintenance process, not least in the telecommunications network. In the maintenance of telecommunication networks, especially 3G -UMTS network, it is necessary to report on UMTS network performance in the previous days. The purpose of this study is to conduct a study of network performance reports in the previous days to help the UMTS network maintainers in analyzing and determining corrective measures in the area in trouble. The results of this study indicate that the RTWP method is helpful in deciding whether NodeB is affected by interference at the maximum acceptance signal threshold of -92dBm/cell. The resulting report resumes can be used as a reference of areas where signal interference is occurring for improvement in the area in which the signal interference is occurring.

Other related research, SMS Gateway-Based Job Vacancies Information System in Pamekasan Region [10], where the research describes The increased growth of the society in Pamekasan from year to year is directly proportional to the number of job seekers increase continuesly. A large number of job seekers is not only due to the inadequate number of jobs, but also because of the slow and precise job information to the proper parties (the people who need jobs). Disnakertrans as an institution formed by the Government has made several attemps to minimize the number of job seekers, but until now the result obtained are not optimal, because there is no systemthat can accommodate the needs of both parties (providers and job seekers). Therefore, the research aims to create a website that accommodates data vacancies and job seekers. Later, the data is automatically going throught the process of weighting by means of the Simple Additive Weighting, this method is expected to optimize the selection of a job based on the latest education, gender, and age that has been mentioned by job seekers when registering. Once the selection process is complete, the job information is sent via SMS Gateway to job seekers. This SMS will send the job information suitable for the number of job seekers who have posted on the website.

Another study, Mobile Ad-hoc Network Design (manet) for Tactical Communication Systems [11], which explained that tactical communication requires a network with self-forming and self-healing characteristics. Node characters can quickly form into a network. However, the military operating environment presents significant challenges, namely unreliable connectivity and limited bandwidth. With these conditions, in this study a tactical communication system was designed that involved aspects of the routing protocol (AODV), Medium Access Control (CSMA) scheme, node formation and the number of nodes that were different for each network. The results of the AODV routing protocol and MAC CSMA protocol with 3 different formations and the increasing number of nodes resulted in a fairly fast network formation time and throughput that still met the Link-16 Enhanced Throughput standard.

Further research, discusses the Traffic Monitoring System On Microtic Mobile App Based On Telegram Notification, from the research results explained [12], Regional Apparatus Organizations (OPD) and Regional Apparatus Work Units (SKPD) are closely related to public services in the city of Surabaya, the complexity of public services managed by each OPD / SKPD often creates several network and web server problems. For this reason, infrastructure management is needed, which can prevent network and web server problems that occur in OPD / SKPD. The research objective is to produce a real-time network and webserver traffic monitoring system with telegram notifications, to prevent obstacles and speed up the process of handling public service problems in OPD/SKPD. This research produces a network traffic monitoring system with a mobile app interface and a website. The mobile app interface can be used by the user while in the field, while the website interface can be used by the user while in the office environment. Testing of the monitoring system was carried out on 10 OPD/SKPD located in Surabaya and 2 demo web servers that provided notifications in the form of UP and Down in real time using telegram

notifications. As well as notifications also through the website by displaying network history and web servers.

Another field research, discusses FTP Server Security Based On IDS And IPS Using Ubuntu Linux Operating System [13], which explains the Vulnerability of server computers on computer networks that can be used by hackers or attackers to take unauthorized actions aimed at disrupting a computer system. In 2020 it was noted that attacks carried out by hackers occurred every 39 seconds, it was also recorded that computers used for research had been attacked 2,244 times per day. Sniffing is a major security threat in computing this form of client-server communication. In this study, build a data security system on an FTP server computer by implementing an Intrusion Detection System (IDS) and an Intrusion Prevention System (IPS). The result is that the Portsentry application is very effective and very good at detecting port scanning activity, and is also very good at blocking attacks from attackers, this is because Portstentry has a mechanism to record the attacker's IP address through the portsentry.ignore.static file system. The Snort application is very effective when detecting all types of attacks, be it ping of death attacks, port scanning or sniffing, this is because Snort has a detection mode mechanism to provide warning information or alerts to network admins if there are intruders through command rules in the Snort file system. So that Portsentry and Snort are quite effective in implementing IDS and IPS systems on FTP servers.

Another field of research, discusses Implementation Of Firewall And Port Knocking As Data Transfer Security On FTP Server Based On Linux Ubuntu Server [14], where in the study it is explained that FTP (File Transfer Protocol) server provides file transfer services between computer machines on a network. FTP is an application level protocol in OSI that is used as a standard file transfer process. Initialize FTP transfer on port number 21 using TCP (Transmission Control Protocol) port as client and server computer data communication. The active port 21 opens the file transfer service between the client and server computers. When the client is exchanging data, it must connect to TCP port number 21, after the server allows it, a new connection is formed via the TCP port as a data exchange path, both uploading and downloading. FTP servers are targets for hackers because their ports are always active and open. With port 21 open, hackers can scan the FTP port used to find out the FTP port number. Furthermore, hackers do sniffing to steal username and password information, so hackers can enter the FTP server which results in data loss on the FTP server. The solution is to use a firewall to close all ports by giving the client access rights that can access the server, the use of port knocking requires the client to authenticate before using the FTP service. The results of the test, by activating the firewall makes hackers unable to find out which ports are active. Using a port knocking authentication system can protect the access rights of using FTP services.

Other research, discusses the Design Of Computer Networks With Bandwidth Management Using Brust Limit And Firewall Techniques As Network Security [15], where the research explains that the progress of information technology today has an impact on the smooth running of a job. This research is applied to a socks distributor. This distributor provides an offline store for purchase transactions and provides hotspot access for visitors. The hotspot network will be connected to the server so it is necessary to apply a filter to restrict visitor access. In addition, to maintain the stability of internet access requires a bandwidth management. To solve this problem, this research uses a firewall feature using Mikrotik RB941 as a security for network access and a burst limit technique for bandwidth management. The test results show that the system can run well. The system can provide access rights as needed where staff can access the internet and store servers while visitors can only access the internet and cannot access store servers. Bandwidth management of the system manages the supply of bandwidth to all users connected to the hotspot. The system will provide maximum bandwidth when the number of users is small so that the network throughput value is high. When the number of users is large, the throughput value will decrease to maintain connection stability for all users.

other related research, discussing about Deep Learning-Based Object Recognition Robot Control Via Web And Mobile Using An Internet Of Things (IoT) Connection [16], where the research describes The paper presents the intelligent surveillance robotic control techniques via web and mobile via an Internet of Things (IoT) connection. The robot is equipped with a Kinect Xbox 360 camera and a Deep Learning algorithm for recognizing objects in front of it. The Deep Learning algorithm used is OpenCV's Deep Neural Network (DNN). The intelligent surveillance robot in this study was named BNU 4.0. The brain controlling this robot is the NodeMCU V3 microcontroller. Electronic board based on the ESP8266 chip. With this chip, NodeMCU V3 can connect to the cloud Internet of Things (IoT). Cloud IoT used in this research is cloudmqtt (https://www.cloudmqtt.com). With the Arduino program embedded in the NodeMCU V3 microcontroller, it can then run the robot control program via web and mobile. The mobile robot control program uses the Android MQTT IoT Application Panel.

other related research, Discusses Planning Of 5G Network Path Loss In Geometry Based Stochastic Concept By Using Linear Regression Methods [17], which in this research is explained This research is a continuation of several previous studies that made 5G network planning using the Free Space Reference Path Loss model. In this study, a 5G network path loss planning was made using the Geometry Based Stochastic model. A forecasting system is created that connects the path loss with the distance between the transmitter and the receiver antenna using the linear regression method. It is important to look at 5G network planning on a different side. The result shows that the path loss value in the light of sight condition is better than the non-light of sight condition with the lowest value of 94.4271 dB at the frequency of 28 GHz and 99.5856 dB at the 73 GHz frequency. Linear Regression analysis shows that the best path loss calculation is the frequency 28 GHz of LOS conditions with MSE is 0.001 and the standard deviation error is 0.0319.

Other related research, discusses The Evaluation Of Land Area Measurement Using GPS Technology [18], which in this study explains The use of GPS is now widely used by various parties, especially in determining the position of object location. GPS can be used to measure the land areas, on both wide and flat areas. It can also be used both at night and day, and even it can be used in bad weather conditions. This paper discusses the evaluation of the measurement result of land area using GPS technology compare to the information containing on the land certificate document. The generated GPS coordinates will be converted into units of meter so that the length of each side can be known. Heron formula is used to calculate the area of a land plotted on the Google Map. From the series of measurement, GPS measurement fall above the land area expressed in the certificate and bellows the meter tape measurement. This measurement still needs to study further to get a stable measurement. But it can be used by

the public community to show the land location to facilitate the land trading. The limitation that must be considered in using GPS is that GPS signal should not be hindered by any barriers such as leafy trees or tall buildings.

other related research, discusses Hillmail: A Secure Email System For Android-Based Mobile Phone Using Hill Cipher Algorithm [19], which in this research describes Nowadays, email has become the most widely communication way in daily life. Email is a very important method of communicating across the internet. During transmission and downloads, it uses protocols which are not secure. Spammers and scammers misuse these protocols to gain access to critical data stored in the email. This triggered concerns because sometimes email is used to exchange confidential messages. To improve security and efficiency of email system, we made an email security system for Android mobile phone using Hill Cipher algorithm. Hill Cipher is a classic cryptography algorithm that uses matrix inverse and matrix multiplication operations to hide the message. The initial stage of the encryption process is forming ciphertext by multiplying the key matrix with plaintext matrix. The contents of encrypted messages can only be read by legitimate recipient who has the key. Converting the ciphertext into plaintext is done by multiplying the ciphertext matrix with the inverse key matrix. The email content can be a plain message or a message with an attached file.

other related research, discusses the Optimal Relay Design Of Zero Forcing Equalization For Mimo Multi Wireless Relaying Networks [20], which in this study is described In this paper, we develop the optimal relay design for multiple-input multiple-output (MIMO) multi wireless relaying networks, when we consider the problem of zero-forcing processing is studied for multi-input multi-output multi-relay communication system in which MIMO source-destination pairs communicate simultaneously. It is assumed that due to severe shadowing effects which communication links can be established only with the aid of relay node. The aim is to design the relay amplification matrix to maximize the achievable communication sum-rate through the relay, which in general amplifying-and- forward relaying mechanisms are considered. The zero forcing (ZF) algorithm has been studied for a MIMO multi relay network by comparing its performance in terms of bit-error-rate (BER) at destination algorithm. In particular, we investigated its performance with and without using the ZF at the relay. Our results demonstrate that the system performance can be significantly improved by using the ZF algorithm at relay (optimal relay ZF algorithm).

3. Research Methods

Limiting bandwidth so as not to overload one user's internet usage which can cause other users to have difficulty accessing the internet.

A. Tools and Materials

1) Tools

• Personal Computer
• Laptops
• ISP
• ISP routers
• Mikrotik

B. Data collection

Data collection is done so that we can find out what tools are used on the agency network so that we can identify problems quickly[21].

C. Problem Identification

At this stage the author makes direct observations at an agency to find problems that occur in the cause of Down's internet access at the agency.

4. Discussion

One of the causes of internet downtime is the absence of bandwidth restrictions on the user which causes the user's internet usage to be overloaded, causing slow Internet use on the network.

I. Results of testing stages

1. Basic Mikrotik Router Settings
2. We set the IP address according to the needs and the IP address that has been determined
3. Setting the IP Address according to the ether that we will use.

Figure 1. Setting the IP Address on each ether that will be used.

4. DNS Server Settings

Figure 2. DNS Server settings

5. Configure Hotspot

Hotspot Installation Stages on Mikrotik.

6. Setting Port interface

Figure 3. Determine which port to use as a hotspot

7. Setting IP Address

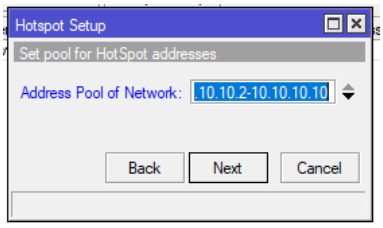

Figure 4. Setting IP Address

8. Setting IP Pool

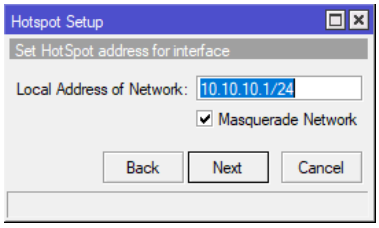

Figure 5. Setting IP Pool

9. Local DNS settings

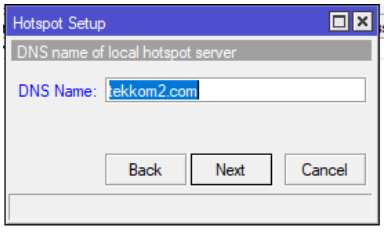

Figure 6. Local DNS settings

This is a DNS name server, where every user who accesses will be directed to this address to login

Figure 7. Success in creating a hotspot server

II. User Configuration Stage

1. Configure User Management

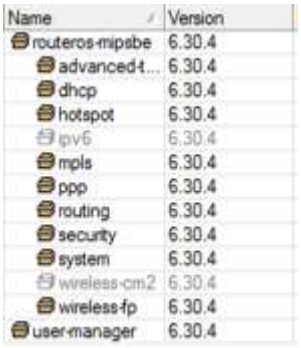

Figure 8. Install the user management package first

2. Display Mikrotik Login Page

Figure 9. Mikrotik Login Page Display

Display admin user management login to login user so they can access the internet.

3. Distribution of Bandwidth for each User

Profil	Bandwidth	
	Download	Upload
Admin	8 MB/sec	8 MB/sec
User	2 MB/sec	2 MB/sec

Figure 10. Distribution of Bandwidth for each User

Distribution of bandwidth for each user so that there is no overload on each user's internet usage.

4. Profile creation

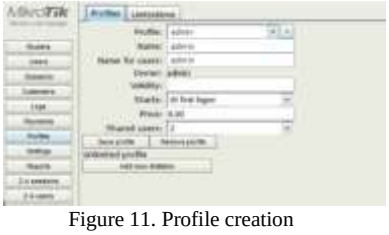

Figure 11. Profile creation

Adjust the configuration as shown in the image.

5. Bandwidth Limit

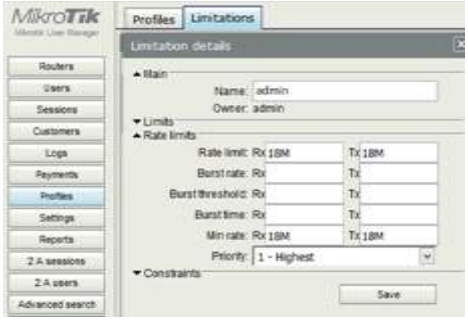

Figure 12. Bandwidth Limit

Adjust the bandwidth limitation according to the profile we created earlier.

6. Create User Hotspot

The last step is to add the user we created earlier.

4. Conclusion

1. As a result of not being limited in bandwidth, it causes an overload on a network which has an impact on disrupting internet traffic on that network.
2. Each agency should implement bandwidth restrictions according to the needs of users using the internet.

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International journal of science, engineering, and information technology
Volume 05, Issue 02, July 2021
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

IBSI Education "SIWESI" Quality Measurement Based on System Technical Viewpoint

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A B S T R A C T

The need for information systems is increasing every year. The information system of an organization or company is useful for managing data to produce useful and effective information that supports activities and all levels of management that use it. The aspect of software quality is one of the important things in the development of a software. To determine the quality of software products, a measurement is needed. IBSI Education, one of which is a Tutoring Institution that uses "SiWeSi" to support administration, view schedules, see student progress, and so on. The success of the software that is built is based on whether or not the software works according to the objectives to be achieved. In the scientific concept of software engineering, the success of software is not only seen from the suitability of the resulting product to existing needs. The success of the software is also seen from the software development process. This study uses the McCall quality model because this method fulfills many components of the assessment and looks at quality from the user's point of view. The quality model used to measure the quality of SIWESI is determined from the results of the literature study.

Keywords: Quality Measurement, SiWeSi, IBSI Education, McCall.

Article History
Received 07 July 20 Received in revised form 25 July 21 Accepted 26 July 21

1. Introduction

The aspect of software quality is one of the important things in the development of a software. To determine the quality of software products, a measurement is needed. Quality measurement involves variables, instruments, and standards. the measurement results of some metrics are directly proportional to the software quality and some other metrics measurement results are inversely proportional to the quality. Metrics that are directly proportional to software quality are function points, Software Maturity Index (SMI), and portability metrics. While the other metrics used are inversely proportional to the measurement of software quality, so to normalize it, subtraction is used to the number 1 . [1][2][3]

Information systems within an organization or company are useful for managing data to produce useful and effective information that supports activities and all levels of management that use [4][5][6]. IBSI Education is a tutoring institution that offers private lessons, group lessons, and classroom lessons. This tutoring institution was established around 2014 and at that time there was no system to control the tutors and the tutoring institution itself.

IBSI Education, one of which is a Tutoring Institution that uses "SiWeSi" to support administration, view schedules, see student progress, and so on. Moreover, "SiWeSi" itself will be used to run business processes in tutoring institutions, so a quality measurement is needed. Which is the quality to be measured from the point of view of technical and system users. This scientific article intends to find out the quality level of "SiWeSi" IBSI Education with deficiencies and recommendations for improvement.

Software quality is needed in system development. Quality will affect the performance of the software. Software quality is the fulfillment of documented functionality and performance requirements. In order for the software to have good performance, it is necessary to properly explore user needs. A product has good quality if it can satisfy most of its users. Software quality assurance is important because it will provide information for management to determine product quality. Quality products can provide certainty and confidence that products can meet quality goals [7].

Software measurement is important because the quality of the system will be known after the measurement, whether the quality of the system is in the good or bad category. One of the testing methods is testing based on McCall's theory of quality [8][9][10]. McCall is a software testing method that has the most complete and in-depth criteria (Product Operation) with five quality factors of correctness, usability, reliability, integrity and efficiency [11][12].

The results of the research in the form of the percentage of the quality of the IBSI Education information system based on user perceptions using the McCall method are expected to provide benefits in the form of information to determine the level of software quality and software utilization based on McCall's theory, so that it can be input and advice for institutions in improving the system in the future. to increase user utilization as expected.

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E-ISSN 2548-4214

Measuring the quality of an information system is very important to do to find out how the current condition of the information system itself is, whether it is still relevant or not with the current conditions, if after the measurement it turns out that the information system is no longer relevant then it can be used as a reference or reference for improvements to make it more efficient. good again.

2. Literature Review

Usability is a measure, where users can operate and use the software without requiring a lot of practice [13]. Usability measurement is determined by two factors, namely: Operability and Training. Operability is the suitability of operating system usage by end-users. Training is the level at which the software can be used by new users. This assessment can be obtained through the analysis of the end-user observation questionnaire [14]. Besides McCall, for usability measurement there is also a Cognitive Walkthrough method. However, this method focuses more on measuring the suitability between the interface design and the application's business processes [15].

McCall's method has been widely used to measure the usability of applications in various fields. Mulyanto (2016) also used McCall to measure the quality of the Academic Information System at a university including design, specifications and coding and obtained good results of 72.68% [16]. Research conducted by Hidayati, et al. in 2017, using the McCall method on the Academic Information System (SIAK) of a polytechnic, the results obtained that the usability factor was able to meet user needs of 65.3% [8]. Research conducted by Arif, et al. Also using the McCall method to measure the usability of the bonus system in a company with a result of 74.72% which indicates the usability of the bonus system in that company is good [17].

This study aims to analyze usability to measure the level, where a product can be used by certain users to achieve their goals more effectively, efficiently, and satisfy Tokopedia web application users. This research is descriptive qualitative using the McCall framework. The research instrument was in the form of a questionnaire as a way of collecting data which would later be analyzed using McCall's quality standards.

From previous research, it can be known what factors are the benchmarks or references for measuring the quality of an information system, Product Operations (Operational characteristics) with five factors used to assess accuracy, reliability, efficiency, usability and integrity, methods McCall has become one of the references for several previous researchers to test the quality of an information system because this method is considered sufficient to meet several aspects of the criteria needed to test the quality of an information system and has proven its reliability. From previous research conducted with the McCall method. The tests carried out only focus on the usability factor on the operational character of McCall's theory, so further research needs to be done for other factors so that the quality assurance of information system software has a better quality value [10].

2.1. Measurement technique

According to Presman, the measurement technique using the McCall method is difficult, and in some cases it is not possible to develop direct measures on quality factors. Therefore, a set of metrics is defined and used to develop expressions for each factor according to the relationship.

1. Measurement Scale

According to Atep Afia Hidayat, et al, scale is a measure that is arranged in such a way that it can sort respondents in a more precise size based on certain variables. The measurement scale that is often used is as follows: Likert scale.

Likert scale is a measurement scale used to measure attitudes, opinions and perceptions of a person or group about social events or phenomena. This social phenomenon has been specifically defined by the researcher, hereinafter referred to as the research variable. The Likert scale makes the variables to be measured are translated into dimensions, dimensions are translated into sub-variables then sub-variables are then translated back into indicators that can be measured. These measurable indicators can be used as a starting point for making instrument items in the form of questions or statements that need to be answered by respondents. Each answer is associated with a form of question or attitude support expressed in words. The Likert scale is used to obtain data on the software validity test. The Likert scale is used to measure the validity factor of the beta test software. The Likert scale will later be used to test the quality factors of correctness, reliability, integrity, usability and efficiency.

2.2. Understanding Information Systems

An information system is a system within an organization that brings together the daily transaction processing needs that support the managerial functions of the organization's operations with the strategic activities of an organization in order to provide certain outside parties with the necessary reports[10].

1. The benefits of having an internal information system
   an agency, namely:
   a) Presenting information to support decision making.
   b) Presenting information to support daily operations.
   c) Presenting information related to management.
2. Some components of information systems can be classified as follows:
   a) Hardware and software that function as machines.
   b) Humans (people) and procedures (procedures) which are humans and procedures for using machines.
   c) Data is a bridge between humans and machines so that a data processing process occurs.

2.3. McCall. method

McCall's method is a model that describes Software Quality Factor or software quality. This model has three main perspectives, namely product operation (operational properties of software), product revision (software ability to undergo changes), and product transition (software adaptability to new environments). Product operation includes several factors, namely correctness, reliability, usability, integrity, and usability. This method contains the most complete software quality criteria or factors. Because the McCall method has good accuracy and detail so that it can be used to test and guarantee the quality of information system software[10].

2.4. Quality Concept

In the perspective of TQM (Total Quality Management) quality is seen more broadly, namely not only as an emphasized result but also includes processes, the environment and people. Meanwhile, according to Gaspers (1997), "quality management can be said as all activities of the overall management function that determine quality policies, objectives and responsibilities, and implement them through quality management tools, such as quality planning, quality control, quality assurance". While the definition formulated by Goeth and Davis (1995), "that quality is a dynamic condition associated with products, services, people, processes, and the environment that meet or exceed expectations". On the other hand, according to Lukman (1999), "the definition of quality varies from controversial to more strategic". Therefore, quality in principle is to keep customer promises so that the parties served are satisfied and expressed so that quality has a very close relationship with customer satisfaction.

3. Research Methods

This study uses a research methodology as shown in Figure 1. The first stage is to determine the quality model by conducting a literature review of the quality model so as to obtain the appropriate model. The next step is to conduct quality testing by applying a predetermined quality model. The next stage is to discuss the results of quality testing so as to obtain the desired results.

Figure 1. Research Methods

The quality model is the quality of the characteristics and the relationship between the elements. Quality methods determine quality requirements and evaluate quality. Comparison of several quality models such as McCall, Boehm[18], dromey[19], FURPS[20], BBN, Star, dan ISO 9126[21]. The results show that McCall's quality model satisfies many components of the assessment and sees quality from the user's point of view. The quality model used to measure the quality of SIWESI is determined from the results of the literature study.

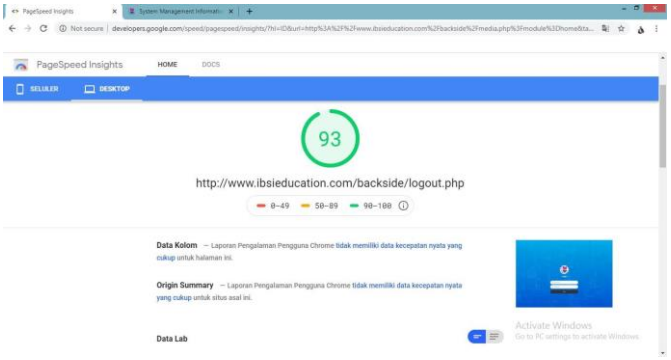
After determining the quality model, then the quality testing stage, measurements are carried out by measuring at each point of view. At this stage, the parties involved in testing are also determined.

4. Result and Discussion

The implementation of the test is detailed in the test on the technical perspective of the system by the user. This test is seen from several factors that are tested using tools such as Page Speed.

4.1. Efficiency

To test the efficiency factor, it is done using an online page speed tool. This



tool is a Google feature that provides facilities to analyze the performance of website page speed with a score. The results of the efficiency test are presented in Figure 2 and Figure 3

Figure 2. Page Speed Test Results

Based on the test results in Figure 2, it is known that the speed of www.ibsieducation.com is in the fast category with a value of 93. This speed is for the desktop version. The time it takes for SIWESI to display the main content of the page and become fully interactive is 0.7 seconds. While the SIWESI speed index, which is how fast the page content looks complete, is 1.1 seconds. In addition to the speed for displaying information, the online page speed also provides information about the potential delay in the first input that the user may experience, which is 20 ms. In addition to the results from the desktop version, the online page speed can also show the speed performance on the mobile version. According to Figure 3, SIWESI is known to enter the category a bit slow with a value of 73. This value is slightly less good than the desktop version.

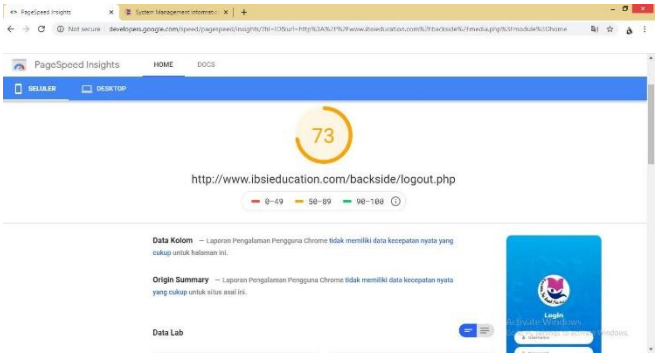


Figure 3. Page Speed Test Results

4.2. Portability

For testing on the portability factor using desktop and mobile devices with multiple browsers. The details of the test are presented in the table below.

Table 1. Table of Portability Factor Testing Details.

Device	Laptop	Smartphone
Browser		
Google Chrome	V	V
Mozilla Firefox	V	V

This result is also related to the access point, SIWESI functionality is the same. It's just that for the printing process, because of the different settings in the Mozilla and Google Chrome browsers, access is easier on the Google Chrome browser. However, for functional printing, both can be done

5. Conclusion

Based on the results of the quality measurement viewed from the technical perspective of the system by the user, the following conclusions are obtained:

Technically, SIWESI's quality is good with the following details:

a) Of the 5 menus, there is 1 menu that is not fully needed, yesterday's honorarium for which the menu was only used to see the amount of last month's honorarium.
b) The efficiency of SIWESI is fast with a value of 93 for desktop and a bit slow 73 for mobile.

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ISSN: 2548-4214
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