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Title: "Automatic Breast Cancer Diagnostic System Using Hidden Markov Model and Modified Backpropagation"

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Automatic Breast Cancer Diagnostic System Using Hidden Markov Model and Modified Backpropagation

ABSTRACT

A diagnostic system needed to help doctors deal with illness. Breast cancer is a dangerous disease that can affect anyone, either women or men. Identification of can be done using a mammography tool that produces a mammogram image. In this study, the improvement or image of images in image processing is done using adaptive histogram, then followed by the segmentation process using HMM. HMM is segmented by calculating the probability values between pixels based on neighboring properties, then two dimensions HMM applied by using Viterbi training to get good features. After getting a vector feature from the HMM results, modified backpropagation utilized the use of hidden layer nodes that are randomly used. It aims to make the training process faster by optimizing linear errors and non-linear errors. The system produces the best accuracy of 80%.

Keyword: Hidden Markov Model, Breast Cancer, Viterbi Training

PREFACE

Assalamualaikum Wr.Wb.

Praise thanks to the Almighty God, Allah SWT that has guided us to finish this research report without any trouble and obstacle. Salawat and salam may always be given to the great prophet Muhammad SAW that has guided us from the darkness to the lightness in the name Islamic religion. Nowadays, cancer is one of the killer disease in the world. One the most common cancer diseases is breast cancer. This research present the early stage breast cancer diagnostic system using Hidden Markov Model. It simulates the data of mammogram then classified the diagnosis. We hope that this output and simulation could give a big impact in the development of medical and mathematical science. Researcher grateful to Dr. Mohd Aftar Abu Bakar, Dr. Noratiqah Mohd Ariff, Rezzy Eko Caraka, M.Sc from Universiti Kebangsaan Malaysia, Dieky Adzkiya, Phd from Institut Teknologi Sepuluh Nopember and Moh. Iqbal, M.Si from 國立台灣科技大學 who has given valuable help and advised us to solve the research problems. Researcher also extremely grateful to Ministry of Religious Affair that has big financially supported us so this research has goes well. This work would not have reached its present form without their invaluable help. Researcher realize that this research is far from perfect. Advice and critics are open for the perfection of the result study. Akhirul kalam.

Wassalamualaikum Wr. Wb.

Surabaya, February 10th 2019
UIN Sunan Ampel Surabaya

TABLE OF CONTENT

ABSTRACT 1
PREFACE 3
TABLE OF CONTENT 4
TABLE OF FIGURE 5
CHAPTER 1 INTRODUCTION 6
1.1 The Objective of the Research 11
1.2 Problem to Discuss 12
1.3 Focus and Scope 12
1.4 Benefit of Research 13
1.5 Previous Studies 13
CHAPTER 2 LITERATURE REVIEW 15
2.1 Breast Cancer 15
2.2 Symptoms of breast cancer 16
2.3 Early detection of breast cancer 16
2.4 Hidden Markov Model 17
2.5 Artificial Neural Network Backpropagation (Backpropagation) 18
CHAPTER 3 RESEARCH METHOD 24
3.1 Types of research 24
CHAPTER 4 RESULT AND DISCUSSION 28
4.1 The Classification Program 28
4.2 The Experimental Result 36
CHAPTER 5 CONCLUSION 49
ATTACHMENT 50
REFERENCES 26

TABLE OF FIGURE

Figure 1. Mammography image for normal breast (left), benign tumor (middle), breast cancer (right)..... 8

Figure 2. Mass..... 9

Figure 3. Microclassification..... 9

Figure 4 Backpropagation ANN Architecture..... 14

Figure 1. Automatic Breast Cancer Diagnose Flowchart System..... 19

Figure 2. Flowchart of Breast Cancer Classification..... 20

Figure 7. Classiffaction program..... 22

Figure 8. The GUI Matlab Appearance..... 22

Figure 9. Browse and choose the mammogram data..... 23

Figure 10. The choosen image..... 23

Figure 11. The Grayscale image..... 24

Figure 12. The Adaptive Histogram Equalization..... 24

Figure 13. The Threshold..... 25

Figure 14. The Clasification tools..... 25

Figure 15. The Clasification result..... 26

Figure 16. A Mammogram Classified to be a Normal..... 26

Figure 17. A Mammogram Classified to be a Cancer..... 27

CHAPTER 1

INTRODUCTION

Living in healthy life is everyone dreaming. An Indonesian adagium "lebih baik mencegah daripada mengobati" means Prevention is better than cure. A good way to apply this proverb is healthy living such as applying good behaviours, do exercise, and see doctors regularly[1].

Indonesia is experiencing an epidemiological transition characterized by increased mortality and morbidity due to non-communicable diseases such as heart disease, cancer, stroke, and diabetes[2]. Non-Communicable Disease caused by lifestyle, bad diet, over rated work, and stress. Non-communicable disease that has the greatest risk is cancer. Cancer risks arise by lack consumption of fruits and vegetables, lack of physical activity (exercise), cigarettes, excessive alcohol consumption, and fast food[3].

Cancer is one of deadliest disease. In 2012, cancer caused about 8.2 million people deaths. According to International Agency for Research on Cancer (IARC) from 14,067,894 new cases of cancer, about 8,201,575 was died [4,5]. One of the most common cancer diseases is breast cancer. In 2012, breast cancer has ranked second as the biggest cause of death in Indonesia. Lung cancer ranked first, found in male about 34.2 % and almost 30% died. While for female, breast cancer has been ranked first new

[1] Anonim, *Masyarakat Hidup Sehat Indonesia Kuat,* (Jakarta: HKN, 2016), p 1.
[2] Anonim, *Situasi Penyakit Kanker*, (Jakarta: Bakti Husada, 2015), p 1.
[3] Ibid, p 2.
[4] Wahidin, M, *Deteksi Dini Kanker Leher Rahim dan Kanker Payudara di Indonesia 2007-2014,* (Jakarta: Bakti Husada, 2015), p 12.
[5] Anonim, *International Agency for Research on Cancer (IARC)/WHO,* (GLOBOCAN 2012), p 6

cases and deaths from cancer, which amounted to 43.3% affected cases and 12.9% deaths[6]. The number of cancer patients in Indonesia is increasing every year, it can be seen from the estimated incidence of breast cancer occurred 40/100,000 women. This number continues to increase since 2002[7].

Factors cause breast cancer which suspect to female, are age, reproductive history, family history, obesity and high-fat foods consumption[8]. Breast cancer is a type of cancer found in breast tissue. Various ways have been done to treat breast cancer, for example with surgery and then performed chemotherapy, but the treatment is not necessarily successful it only postpone the death risk of the patient. The late cancer diagnosis causes frightening the patient and mays affect the patient's psychological. Therefore, prevention and early detection needed to reduce new cases of cancer in Indonesia.

Early diagnosis is required to determine whether breasts are abnormal or normal. One of the early observation is mammography. Mammography test is a screening test, especially breast cancer, which can see early cancer cells that grow in the breast, abnormalities in the breast so that an early treatment can be done[9]. Mammography resulted in two tumor diagnoses of benign tumors and malignant tumors (cancer). Mammography images were analysed into three classes of normal

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[6] Wahidin, M, *Deteksi Dini Kanker Leher Rahim dan Kanker Payudara di Indonesia 2007-2014,* (Jakarta: Bakti Husada, 2015), p 12.
[7] Ibid, p 7.
[8] Makhfudhoh, N. U. *Klasifikasi Kanker Payudara Dari Citra Mammografi Menggunakan Model Fuzzy Neural Network.*, (Yogyakarta: Universitas Negeri Yogyakarta , 2014), p 1.
[9] Sabrida, H, *Peranan Deteksi Dini Kanker untuk Menurunkan Penyakit Kanker "Stadium Lanjut",* (Jakarta: Bakti Husada, 2015), p 16.

mammography, benign mammography and benign mammography. Figure 1 shows image of three classes of mammography.

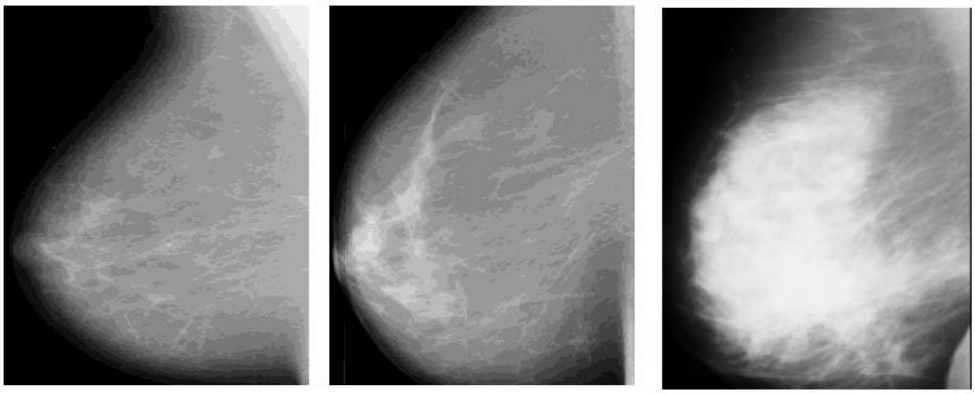

Figure 3. Mammography image for normal breast (left), benign tumor (middle), breast cancer (right)[10]

The detection of abnormalities could be identified by looking at the presence of mass or the presence of microclasification on the image mammogram[11]. The Mass in mammographic photographs is an area of textural patterns with shapes and borders of certain areas, while the micrococlassification in mammographic photos are small calcium deposits present in breast tissue seen as small white dots around the breast tissue[12]. Figure 2 and Figure 3 are mammogram images of mass and microclassification.

[10] Makhfudhoh, N. U. *Klasifikasi Kanker Payudara Dari Citra Mammografi Menggunakan Model Fuzzy Neural Network.*, (Yogyakarta: Universitas Negeri Yogyakarta , 2014), p 12.
[11] Bebby Dwi Junita, Ekstrasi Fitur dan Klasifikasi Menggunakan Metode GLCM dan SVM pada Citra Mammogram untuk Identifikasi Kanker Payudara, (Universitas Gunadarma, 2017), p 19
[12] Ibid,

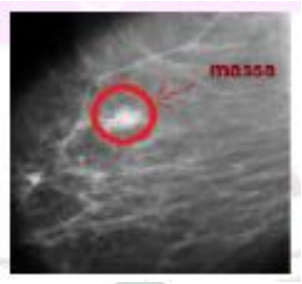

Figure 4. Mass

Figure 5. Microclassification

Based on three classes of mammography imagery, mass and microclassification, classification needs to be done to trace the distribution and characteristics of tumor diagnostic results. The classification can be accomplished by functional approach techniques known as Artificial Intelligence. Artificial Intelligence is one branch of computer science that learns how to create intelligent machines that have human ability[13]. There are some Artificial Intelligence methods such as fuzzy logic, artificial neural network, Hidden Markov Model, and Genetic Algorithm. Sometime, these methods are combined to get a perfect algorithm.

[13] Prasetyo, E, *Data Mining, Mengelola Data Menjadi Informasi Menggunakan Matlab,* (Yogyakarta: ANDI Yogyakarta, 2014), p 3

The studies of breast cancer classification widely performed and published using various methods. However, the studies ware limited to knowing whether a previously performed tumor diagnosis indicated a malignant or benign tumor. For instance, research conducted by Noor Uswah Makhfudhoh about the classification of breast cancer from mammography image using fuzzy neural network[14]. In addition, Adam Mizza Zamani implements Genetic Algorithm on Backpropagation Neural Network Structure for Breast Cancer Classification[15], Eshlaghy create a machine learning technique for breast cancer prediction[16], Rafiul Hassan using fuzzy HMM for breast cancer identification[17], Rafayah Mousa using wavelet and artificial neural network analysis methods for the diagnosis of breast cancer[18], and Murat Karabak detect breast cancer using artificial neural network[19].

Breast tumor classification can also be analysed using statistical parameters obtained from mammography images extraction. The classification is divided into three, normal and abnormal; mass and microclasification; benign and malignant. Early breast cancer diagnosis system researched using the Hidden Markov Model and Backpropagation Modification on mammogram data. Hidden Markov Model (HMM)

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[14] Makhfudhoh, N. U. *Klasifikasi Kanker Payudara Dari Citra Mammografi Menggunakan Model Fuzzy Neural Network.*, (Yogyakarta: Universitas Negeri Yogyakarta , 2014)

[15] Zamani, A. M, Amaliah, B., & Munif, A. Implementasi Algoritma Genetika pada Struktur Backpropagation Neural Network untuk Klasifikasi Kanker Payudara , (*Jurnal Teknik ITS Surabaya* , 2012), p.222-227.

[16] Eshlaghy, e. a, Using Three Machine Learning Techniques for Predicting Breast Cancer Recurrence, (*J Health & Medical Informatics*, 2013), p 1-3.

[17] Hassan, R., & al., e, Breast Cancer identification using HMM-fuzzyapproach, (*Computers in Biology and Medicine* , 2010), p 240-251.

[18] Mousa, R., Munib, Q., & Mousa, A, Breast Cancer Diagnosis System, (*J. Jordan,* 2005), p 713-723.

[19] Karabatak, M, An Expert System for Detection of Breast Cancer based on Association Rules and Neural Network, (J. Turkey, 2009), p 3465-3469.

used for mammogram features extracts while the modification of Backpropagation used to classify the features.

In this study Hidden Markov Model (HMM) is a suitable statistical model in image management so it suitables to extract the mammogram features[20]. Backpropagation suitables for control system, solving time prediction problems, and pattern classification. In case of breast cancer early diagnosis, Backpropagation used to classify the features of mammogram data.

Based on these reasons, we use the Hidden Markov Model and Backpropagation to develop breast diagnosis system with the title "**Automatic Breast Cancer Diagnostic System Using *Hidden Markov Model* and Modified *Backpropagation***". Hopefuly this research provides an appropriate alternative diagnosis and speed up breast health examination. Nowaday, Malaysia concerns on doing disease and biomedical research. Therefore, we are planning to do a collaborative research with UTM (Universiti Teknologi Malaysia).

1.1 The Objective of the Research

The objective of the study are:

1. How to develop early-stage breast cancer diagnostic system using Hidden Markov Model and Modification of Backpropagation on mammogram data?

[20] Prasetyo, M. E, Teori Dasar Hidden Markov Model, (*Jurnal JI)*, p 1.

2. How is the results and simulation of early-stage breast cancer diagnosis system using Hidden Markov Model and Modification of Backpropagation on mammogram data?

1.2 Problem to Discuss

Based on the description outlined above, this study will discuss the formulation of the problem as follows:

1. Developing early-stage breast cancer diagnostic system using Hidden Markov Model and Modification of Backpropagation on mammogram data.
2. Hidden Markov Model and Modification of Backpropagation are suitable to early-stage breast cancer diagnostic system on mammogram data.

1.3 Focus and Scope

Focus and scope in this research are:

1. Data used in the research is Mammogram data.
2. Classification is divided into three, normal and abnormal; mass and microclassification; and benign and malignant.

1.4 Benefit of Research

The benefit of the research is:

1. Theoretically

   This study can combined mathematics and health

2. Practically

   a. For Researcher

      Enhance knowledge of Hidden Markov Model model and modification of bacpropagation in early breast cancer diagnosis system.

   b. For Doctor

      Provides an alternative method in breast cancer diagnose and classification.

   c. For UIN Sunan Ampel Surabaya

      Provides reference especially for mathematics department students.

1.5 Previous Studies

There are a lot of studies about breast cancer. Such as, research conducted by Noor Uswah Makhfudhoh about the classification of breast cancer from mammography image using fuzzy neural network[21]. In addition, Adam Mizza Zamani implements Genetic Algorithm on Backpropagation

[21] Makhfudhoh, N. U. *Klasifikasi Kanker Payudara Dari Citra Mammografi Menggunakan Model Fuzzy Neural Network.*, (Yogyakarta: Universitas Negeri Yogyakarta , 2014)

Neural Network Structure for Breast Cancer Classification[22], Eshlaghy create a machine learning technique for breast cancer prediction[23], Rafiul Hassan using fuzzy HMM for breast cancer identification[24], Rafayah Mousa using wavelet and artificial neural network analysis methods for the diagnosis of breast cancer[25], and Murat Karabak detect breast cancer using artificial neural network[26].

[22] Zamani, A. M, Amaliah, B., & Munif, A. Implementasi Algoritma Genetika pada Struktur Backpropagation Neural Network untuk Klasifikasi Kanker Payudara , (*Jurnal Teknik ITS Surabaya* , 2012), p.222-227.
[23] Eshlaghy, e. a, Using Three Machine Learning Techniques for Predicting Breast Cancer Recurrence, (*J Health & Medical Informatics*, 2013), p 1-3.
[24] Hassan, R., & al., e, Breast Cancer identification using HMM-fuzzyapproach, (*Computers in Biology and Medicine* , 2010), p 240-251.
[25] Mousa, R., Munib, Q., & Mousa, A, Breast Cancer Diagnosis System, (*J. Jordan,* 2005), p 713-723.
[26] Karabatak, M, An Expert System for Detection of Breast Cancer based on Association Rules and Neural Network, (J. Turkey, 2009), p 3465-3469.

CHAPTER 2

LITERATURE REVIEW

2.1 Breast Cancer

Cancer is a body cell that undergoes mutations (changes), grows uncontrollable, and divides faster than normal cells. Cancer cells do not die, but grows and continues to be invasive so that normal cells in the body pressed and even died[27]. Breast cancer is a type of cancer found in breast tissue. Breast cancer is the most common disease affects female.

Breast cancer is one of the most common cancer diseases. In 2012, breast cancer has ranks second after lung cancer as a new case and the biggest cause of death in Indonesia. The first ranks, Lung cancer, found in the male of about 34.2% as a new case of lung cancer and about 30.0% died. While in the female, breast cancer has been ranked first new cases and deaths from cancer, which amounted to 43.3% affected cases and 12.9% deaths[28]. In Indonesia, The number of cancer patients is increasing every years, it can be seen from the estimated incidence of breast cancer that occurred in Indonesia for 40 per 100,000 women. This number continues to increase since 2002[29].

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[27] Mulyani, N. S., & Nuryani, *Kanker payudara dan PMS pada Kehamilan*, (Yogyakarta: Nuha Medika, 2013), p 45-46.
[28] Wahidin, M, *Deteksi Dini Kanker Leher Rahim dan Kanker Payudara di Indonesia 2007-2014,* (Jakarta: Bakti Husada, 2015), p 14
[29] Ibid,

Some factors causing breast cancer are

- Age
- Reproductive history
- Family history
- Obesity
- High fat foods consumption[30].

2.2 Symptoms of breast cancer

There are some abnormal changes that are symptoms of breast cancer:

a. Swelling of all or part of the breast,
b. Irritation of the breast skin,
c. Pain in the nipple,
d. Nipple sink into,
e. Redness or thickening of the skin of the nipple or breast,
f. Discharge from the nipple other than milk,
g. There is a lump in the armpits.

2.3 Early detection of breast cancer

A number of studies have shown that breast cancer detection as well as therapy that can increase life expectancy and provide more treatment to patients. After a treatment, It is estimated that 95% of women diagnosed in

[30] Makhfudhoh, N. U. *Klasifikasi Kanker Payudara Dari Citra Mammografi Menggunakan Model Fuzzy Neural Network.*, (Yogyakarta: Universitas Negeri Yogyakarta , 2014), p 9.

early stages of breast cancer survive more than five years after. Therefore, a lot of doctors recommend that women do a ‘sadari' (check their own breasts at the time of menstruation) at home on a regular basis and recommend doing an annual routine check to detect breast lumps[31]. One of the early breast cancer detection tests is mammography.

Mammography is the process of human breast examination using low-dose X-rays[32].. Examination using mammography produces an image called mammography image. The mammography method is relatively safe because it uses low dose X-rays of about 0.7 milliSievert (mSv). Moreover, mammography allows doctors to see more clearly the lumps in the breast that are not palpable and see changes in breast tissue[33].

2.4 Hidden Markov Model

Hidden Markov Model is the development of statistical model of Markov model. This model developed by Andreyevich Markov[34]. The Hidden Markov Model is a statistical model in which a modeled system is assumed to be a Markov process with unknown parameters and the hidden parameters must be determined from the observable parameter[35].

[31] Mulyani, N. S., & Nuryani, *Kanker payudara dan PMS pada Kehamilan*, (Yogyakarta: Nuha Medika, 2013), p 45-46
[32] Ibid,
[33] Ibid, p 46
[34] Prasetyo, M. E, Teori Dasar Hidden Markov Model, (*Jurnal JI)*, p 1
[35] Lestari, A. P, *Rancang Bangun Pengenalan Penyakit Darah Menggunakan Hidden Markov Model.* (Jakarta: Universitas Indonesia , 2008), p 9.

In the ordinary Markov model, state (x) is directly visible to the observer. Therefore, the probability of the tarnsition is the only parameter. Hidden Markov Model has been studied extensively in various fields of statistics. This model is seen as a parametric bivariate process in discrete time. The process occurring in Hidden Markov Model is a homogeneous finite-state of the Markov Model and cannot be observed[36].

2.5 Artificial Neural Network Backpropagation (Backpropagation)

Artificial Neural Networks Backpropagation or commonly referred to Bacpropagation is a supervised learning algorithm and is commonly used by simple Perceptron neural network with multilayer (Mutilayer Perceptron) to change the weights connected to all neurons in the hidden layer. Backpropagation algorithm developed in 1986 by Rumelhart, Hinton, and Williams. Backpropagation algorithm uses output error by changing the value of the weights in the backward direction.

The basic principle Backpropagation algorithm consists of three vases, namely[37]:

[36] Prasetyo, M. E, log cit p 1
[37] Siang, J. J, *Jaringan Syaraf Tiruan dan Pemograman menggunakan Matlab,* (Yogyakarta: ANDI Yogyakarta, 2005) p 102.

a. *Feed forward*

This phase is the calculation phase of activation value. Each neuron in the hidden layer and output layer calculates each activation value according to the activation function used.

b. Calculation Phase dan *Backpropagation error*

Each neuron output calculates the error information between the target value and the resulting output. The information will be sent to the layer below.

c. Weight adjustment phase

Any output neuron and hidden neuron changes the bias and weights according to the error values

In addition, Charatcteristic of Artificial Neural Network are:

a. Multilayer Network

In this network, the architecture used is one input layer, one output layer, and one hidden layer. Every neuron on a single layer in Backpropagation gets an input signal coming from all neurons on the previous layer along with a bias signal.

b. Activation Function

This function is required to be continuous, differentiable, and not descent. This function used Backpropagation JST :

1) *Sigmoid biner* function that output interval is [0,1]

$$y = f(x) = \frac{1}{1+e^{\sigma x}}$$

(2.1)

with $f' = \sigma\, f(x)[1 - f(x)]$

2) *Signoid bipolar* function which has output interval [-1,1]

$$y = f(x) = \frac{1-e^{-x}}{1+e^{-x}}$$

(2.2)

with $f'(x) = \frac{\sigma}{2}[1 + f(x)][1 - f(x)]$

Figure 4 shows Backpropagation Artificial neural network model (ANN) model with one hidden layer.

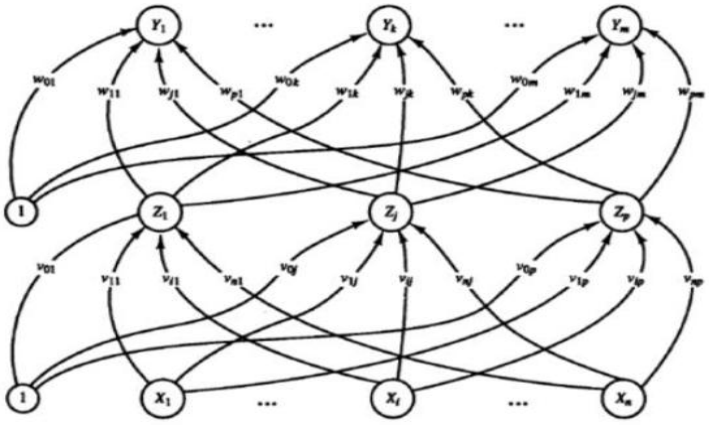


Figure 6. Backpropagation ANN Architecture[38]

[38] Ibid, p. 102.

While the steps of the Backpropagation algorithm are described as follows[39]:

1. Initialization of weights (take initial weight with a small enough random value).
2. Do the following steps until the condition is stop or *FALSE.*.
   a. For each pair of training data do the following steps:

   Feedfoward:

   1) Each input unit (x_i, i = 1, 2, 3,..., n) receives the signal x_i and passes the signal to all units on each layer above (hidden layer).
   2) Each hidden unit $z_j, j = 1,2,3, \dots, p)$ sums the weighted input signals into the following equation:

      $$z_{in_j} = v_{0j} + \sum_{i=1}^{n} x_i v_{ij} \quad (2.3)$$

      use activation function to calculate output signal:

      $$z_j = f\left(z_{in_j}\right) \quad (2.4)$$

      send the signal to all unit in layer above.
   3) Every output unit ($Y_k, k = 1,2,3, \dots, m$) sums weighted input signal using:

      $$y\_in_k = w_{0k} + \sum_{i=1}^{p} z_j w_{jk} \quad (2.5)$$

[39] Ibid, p. 102.

use activation signal to calculate output signal:

$$y_k = f(y\_in_k) \quad (2.6)$$

and sent the signal to all unit in layer above.

Backpropagation

4) Every output unit ($Y_k, k = 1,2,3, \dots, m$) will receive the target pattern associated with the learning input pattern, then calculate the error information with:

$$\delta_k = (t_k - y_k) f'(y\_in_k) \quad (2.7)$$

Then calculate the weight correction (which will be used to fix the value of w_{jk}), this calculation uses:

$$\Delta w_{jk} = \alpha\ \delta_k\ z_j \quad (2.8)$$

Calculate the correction of its bias values to improve the value of w_{0k} using:

$$\Delta w_{0k} = \alpha \delta_k \quad (2.9)$$

send δ_k to the existing units under the lining.

5) Every hiden unit ($z_j, j = 1,2,3, \dots, p$) sums units result on layer above by

$$\delta\_in_j = \sum_{k=1}^{m} \delta_k w_{jk} \quad (2.10)$$

Then multiplys the value with the differential of its activation function to calculate the error value information:

$$\delta_j = \delta_{in_j} f'(z\_in_j) \quad (2.11)$$

Then calculate the value of weight that serves to fix the value of v_{ij} : $\Delta v_{jk} = \alpha \delta_j x_i$ (2.12)

Then calculate the value of bias that will be used to improve the value v_{oj} using:

$\Delta v_{0j} = \alpha \delta_j$ (2.13)

6) Every output unit ($Y_k, k = 1,2,3, \dots, m$) will improve the value of bias and weight of ($j = 0,1,2, \dots, p$) :

$w_{jk}(baru) = w_{jk}(lama) + \Delta w_{jk}$ (2.14)

Every hidden unit ($z_j, j = 1,2,3, .., p$) serves to improve the value of bias and its weight ($i = 0,1,2, \dots, n$):

$v_{ij}(baru) = v_{ij}(lama) + \Delta v_{ij}$ (2.15)

b. Test until stop

CHAPTER 3

RESEARCH METHOD

3.1 Types of research

Research on early diagnosis system of breast cancer Automatic Using Hidden Markov Model and Backpropagation included into applied research. The results of this early diagnosis aims as an alternative to appropriate diagnosis and speed up breast health examination.

1. Need Assessment

   Early diagnosis of breast cancer is one of the important things that is must be considered. One of the most common cancer diseases is breast cancer. The late diagnosis of cancer is a frightening specter for the patient and may affect the patient's psychological condition. Early diagnosis needed to determine whether breasts are normal or abnormal.

   From the existing problems, a literature study that focuses on the problems needed to be analyzed. This literature study aims to make researchers better understand the concept of problems related to the parameters and methods applied to achieve maximum results.

2. Collect and analyze data

   The data used in this study are MRI mammogram images. MRI mammogram images have different image quality so image improvement is needed. The first step taken was the Region of Interest (ROI) in the form

of trimming 360 x 360 pixels on breast cancer cells. The steps in ROI method are grayscale, binarization and image cropping. Then, applied adaptive histogram equalization is used to improve the image that having a range of distant values pixel distribution. Next segmentation the feature using double thresholding to detect features of breast cancer. Next, segmentation is done so that it can be opened with a background. So that the vector features can be obtained using Hidden Markov Models. The Hidden Markov Model is a statistical model based on a stochastic process called the Markov chain. Segmentation results are used as input to the classification process using Backpropagation.

3. Test and Evaluation

Feature extraction using Hidden Markov Model is done on different data. A combination of Double Thresholding and HMM is used for feature segmentation in the image. HMM used for Classification of breast cancer in Thermography Images and hybrids with Double Thresholding in breast cancer. HMM used for image character segmentation. Backpropagation modifications used for feature classification to obtain early diagnosis in breast cancer patients. Figure 5 is a flowchart of the early diagnosis of breast cancer.

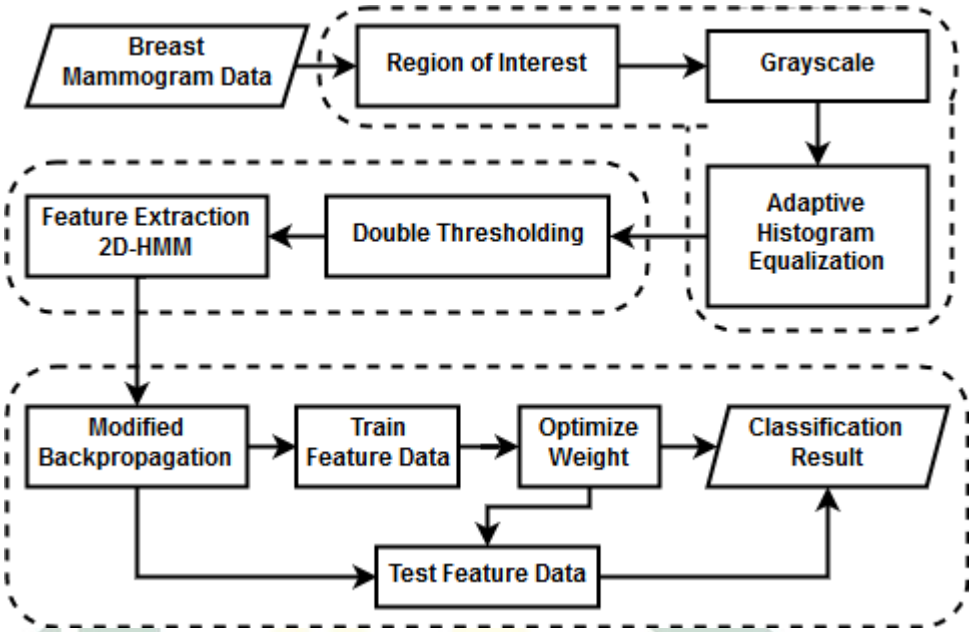


Figure 7. Automatic Breast Cancer Diagnose Flowchart System

Figure 7 represents:

- Breast image data is mammography data from multiple data samples
- Breast cancer mammogram data is gray image data (gray image)
- From gray scale mammography data applied adaptive histogram equalization
- Then thresholding
- Next goes into feature extraction, selection features using the hidden markov model by dividing the HMM parameters into HMM training and HMM testing.
- HMM training and testing results classified using Backpropagation.

The classification is divided into three categories, normal and abnormal, mass and microclasification, benign and malignant using backpropagation as Figure 8.

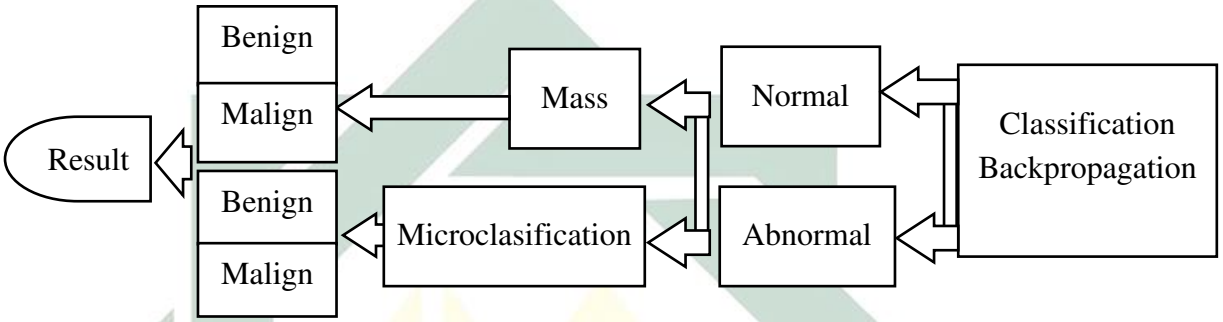


Figure 8. Flowchart of Breast Cancer Classification

4. Report

Preparation of reports can be done when the process, implementation, and evaluation has been done and can be made as a paper with attention to aspects of functions and information that can be useful for some parties. The composition of this report contains the design of the research process and the results analysis that will be obtained during the research process, in which the output of this study shows an early diagnosis system of breast cancer Automatic Using Hidden Markov Model and Backpropagation.

CHAPTER 4

RESULT AND DISCUSSION

4.1 The Classification Program

The diagnostic program is developed using Matlab based on flowchart shows in figure 6. The program evaluates a mammogram data which is chosen by user.

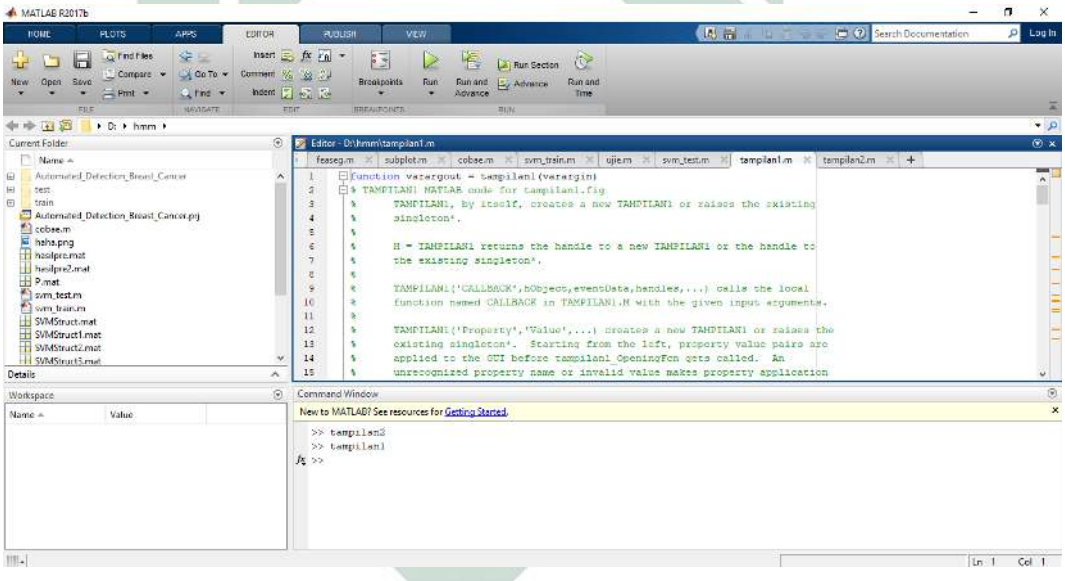


Figure 7. Classiffaction program

The program is designed to be a user friendly program. A user run the program and wait for the GUI Matlab appear. The GUI appearance is shown in the following figure.

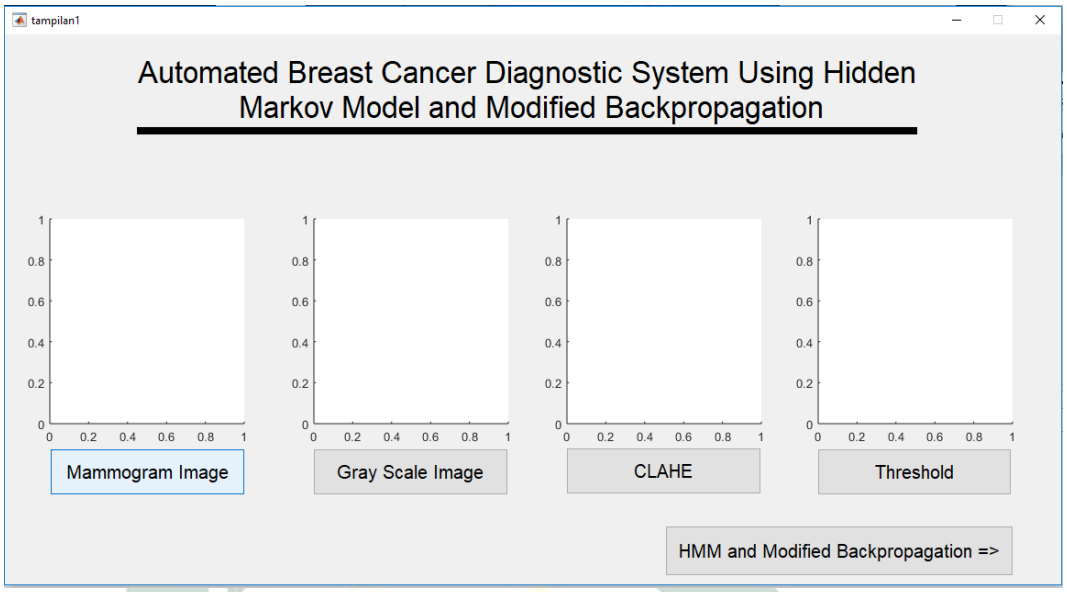


Figure 8. The GUI Matlab Appearance

Once the GUI appeared, user choose a mammogram data by clicking the mammogram image button and it will browse the data through the computer (figure 9). While it founds just click it and the choosen image will appear above the mammogram image button (figure 10).

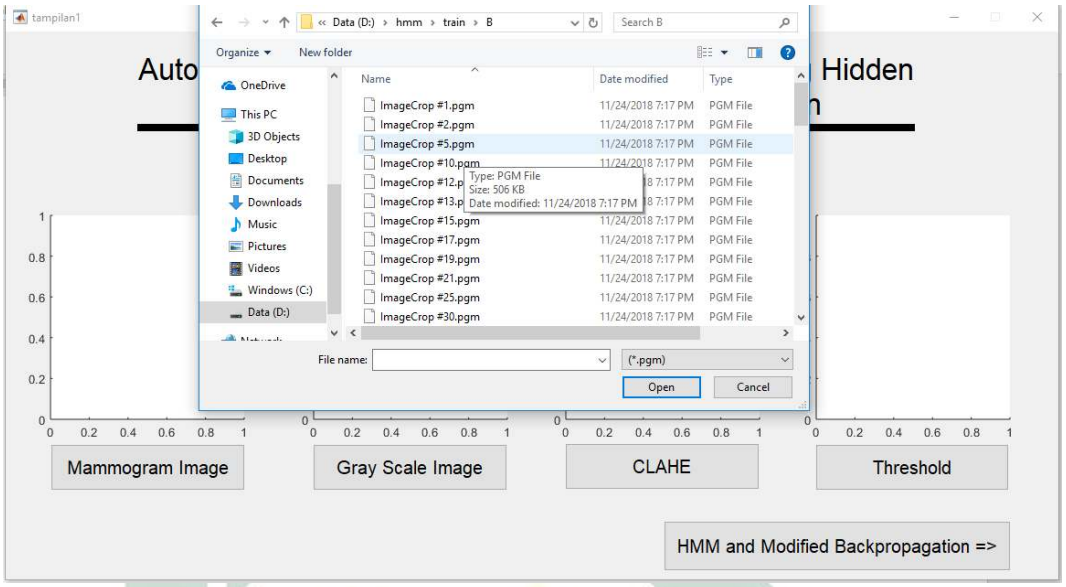


Figure 9. Browse and choose the mammogram data

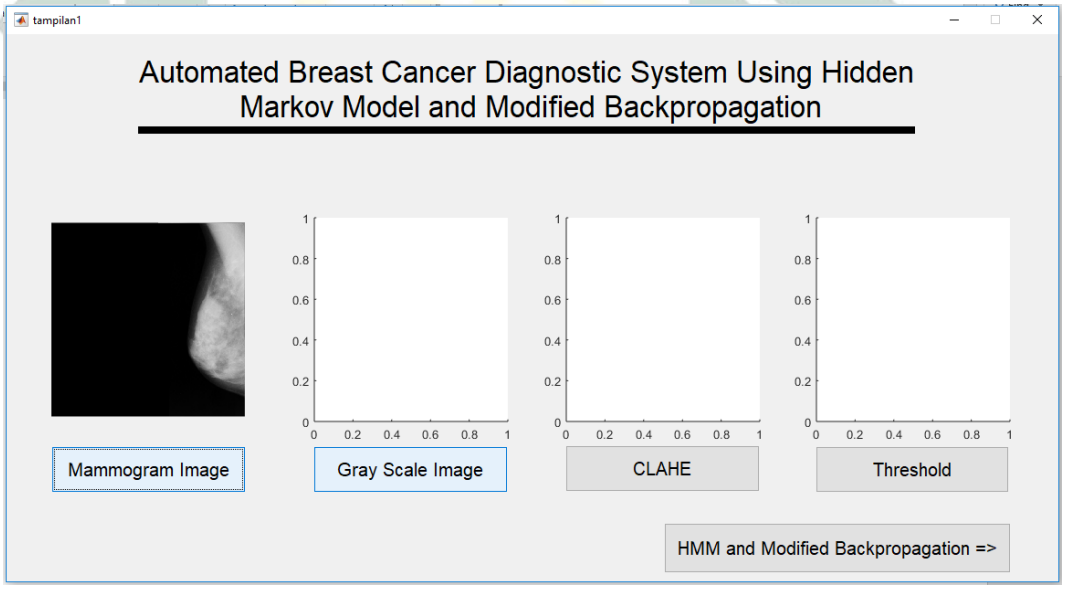


Figure 10. The choosen image

Then click following button in sequence. Click Gray Scale Image to convert the image chosen into grayscale (figure 11). Adaptive Histogram

Equalization (figure 12) appear while the CLAHE button clicked. Threshold image (figure 13) is resulted by Treshhold button.

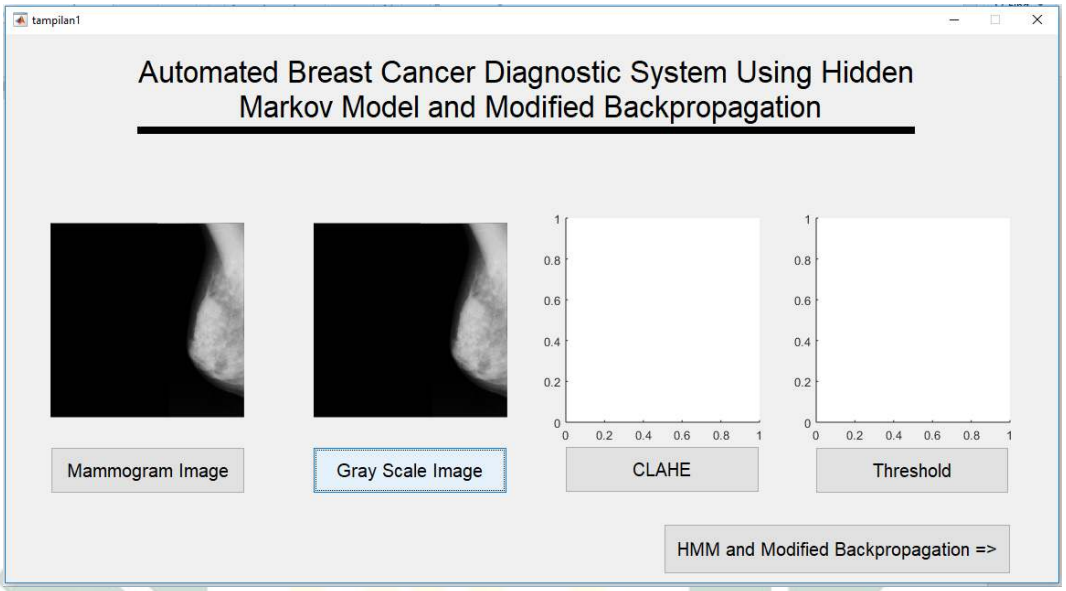


Figure 11. The Grayscale image

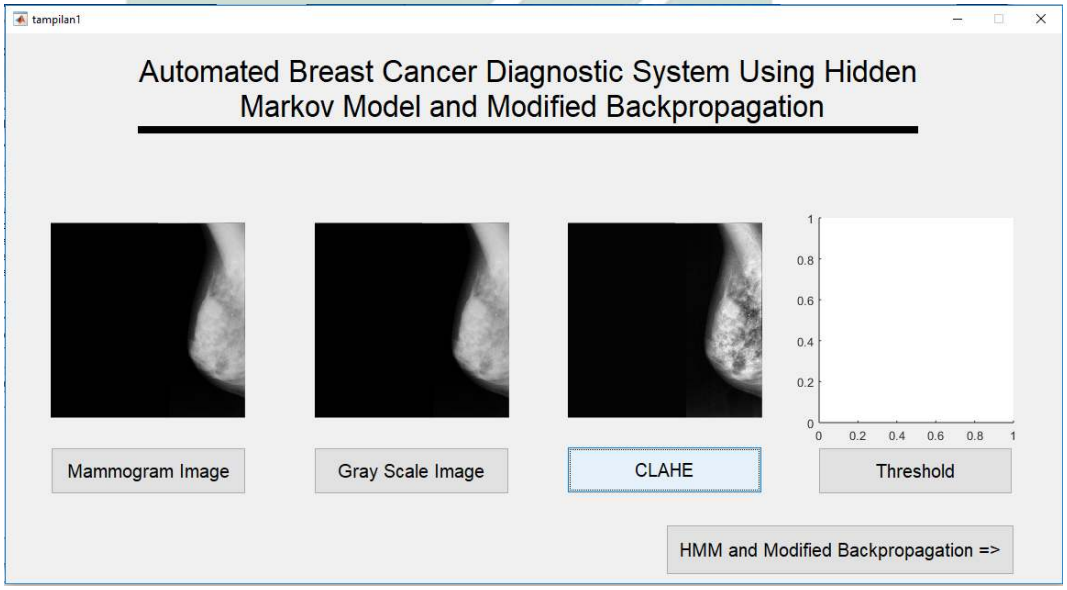


Figure 12. The Adaptive Histogram Equalization

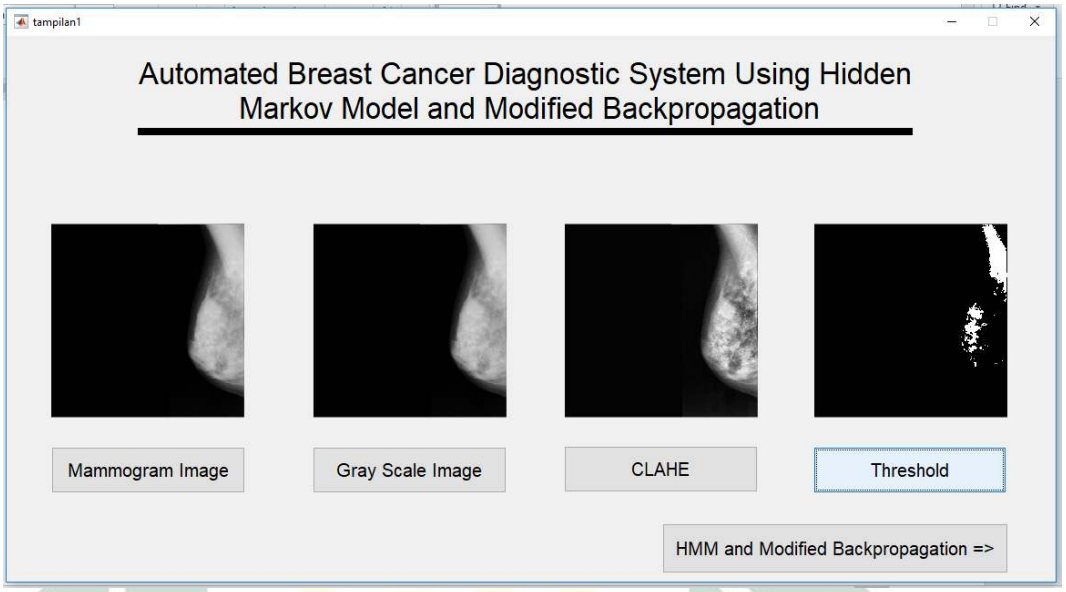


Figure 13. The Threshold

The threshold resulted will be evaluate by feature extraction using HMM then classified using Modified Backpropagation. Click the HMM and Modified Backpropagation and wait figure 14 appear then click the run button then the classification performs and obtains a result (figure 15).

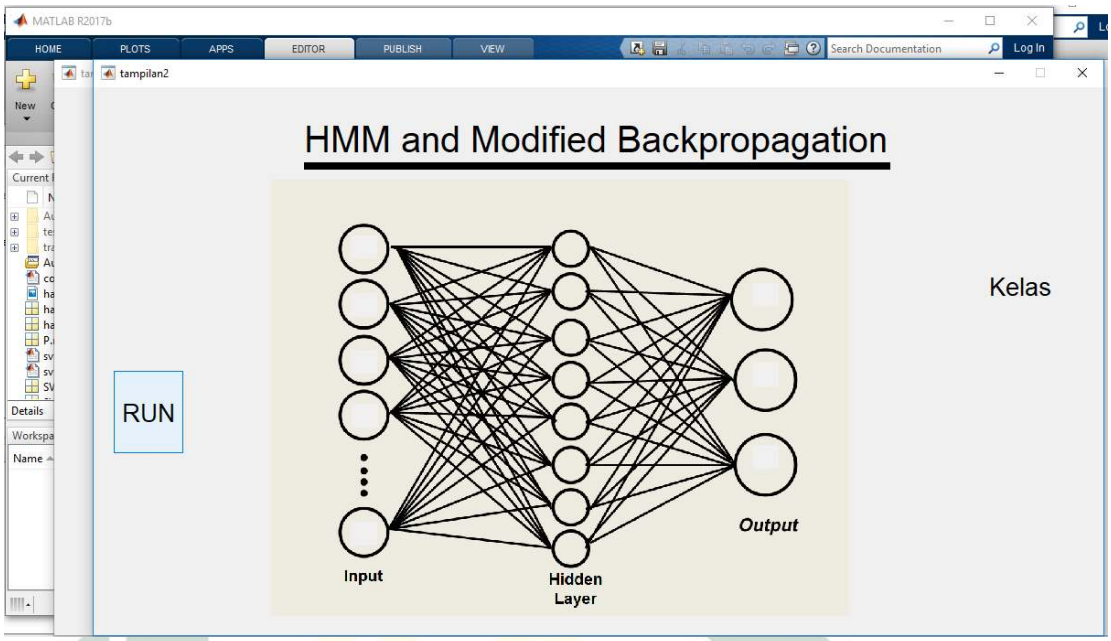


Figure 14. The Clasification tools

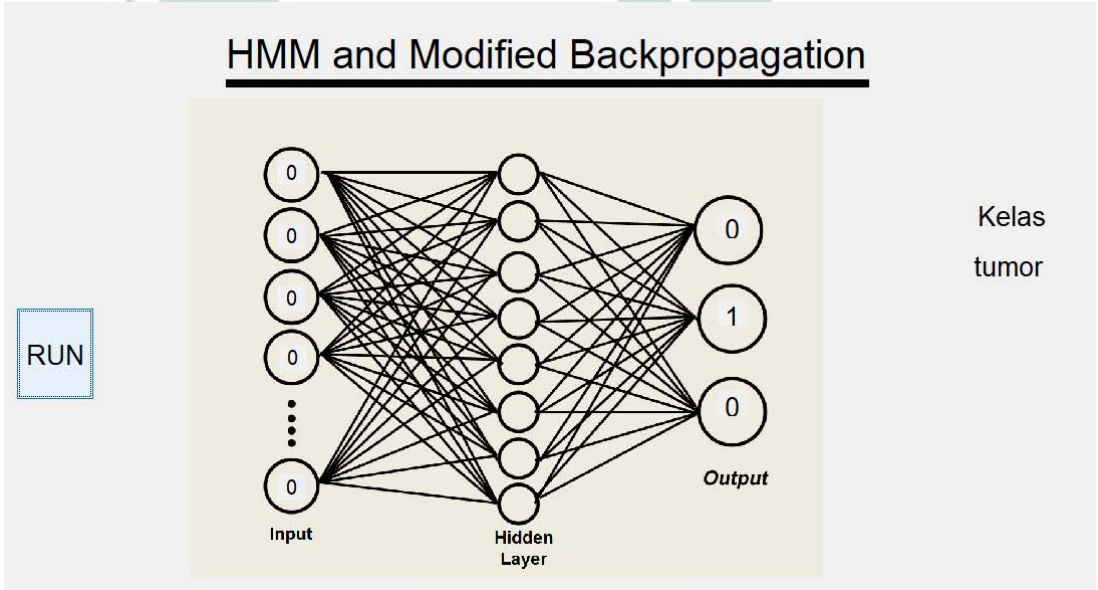


Figure 15. The Clasification result

The follwing figure show mammogram that classified to be a normal (figure 16) and a cancer (figure 17) resulted by performe the program.

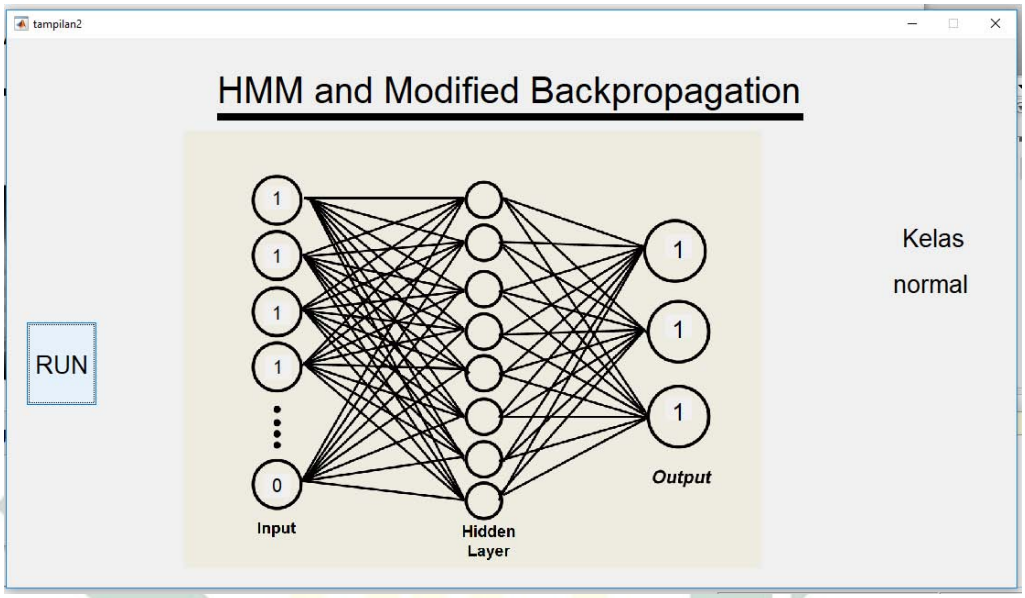


Figure 16. A Mammogram Classified to be a Normal

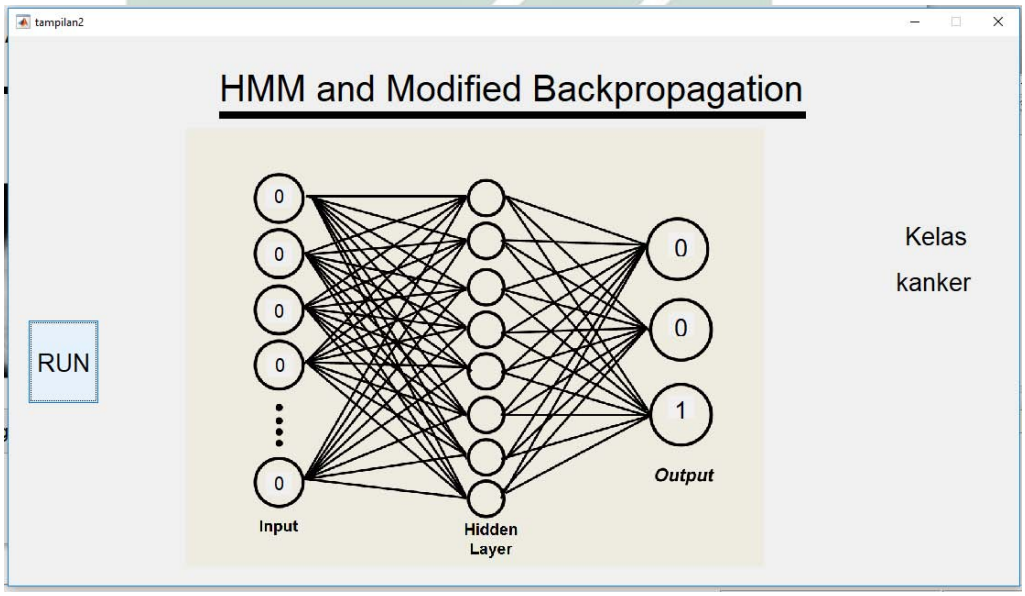


Figure 17. A Mammogram Classified to be a Cancer

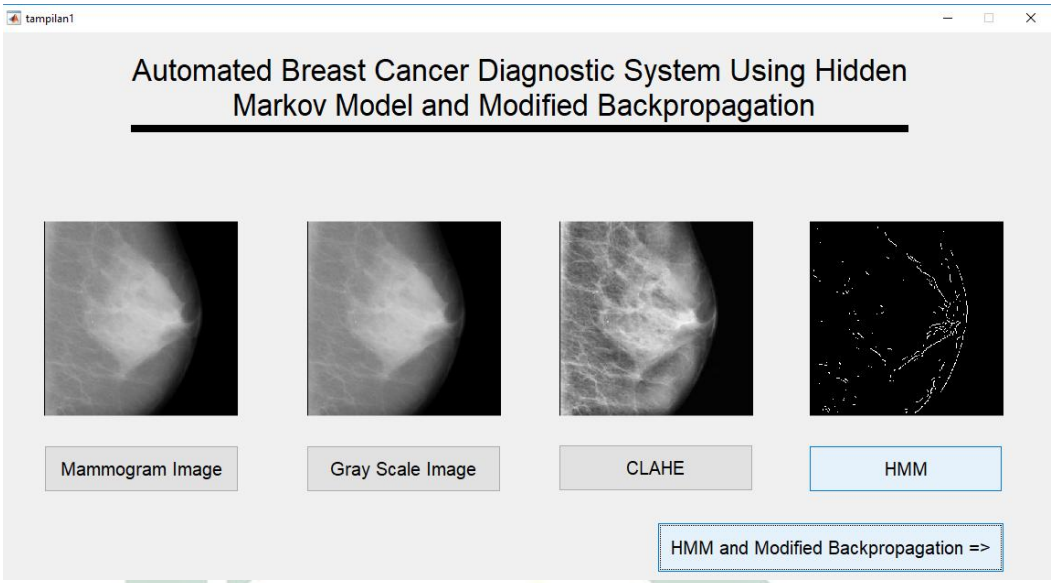


Figure 18. The Threshold

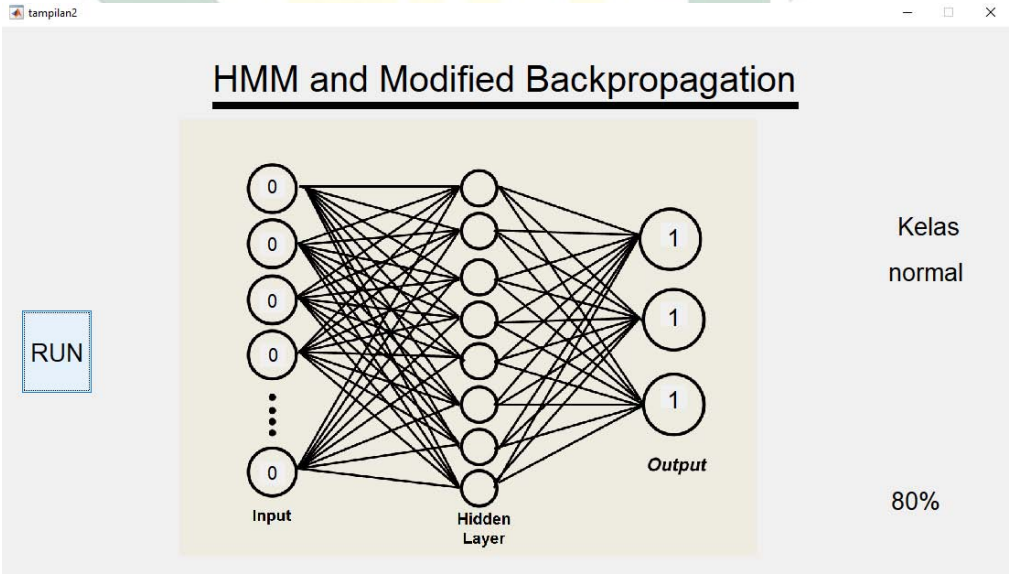


Figure 19. A Mammogram Classified to be a Cancer

4.2 The Experimental Result

The data used in this study are MRI mammogram images consisting of normal mammogram images, benign mammogram images, and 322 malign mammogram images. The data is divided into two groups of data, namely data for training. In the backpropagation classification process, the input is a feature vector from the image segmentation process using Hidden Markov Models. The segmentation process using the Hidden Markov Model method produces a feature vector with a size of 332 x 129600. This value is used as input for the backpropagation classification process. Vector features of segmentation results are presented in Table 4.1.

Table 4.1 Value of Input Backpropagation Results of Process Hidden Markov Models

Data ke	1	2	3	⋯	129598	129599	129600
1	0	1	1	⋯	0	0	1
2	0	0	0	⋯	1	1	0
3	0	0	0	⋯	0	0	0
4	0	1	0	⋯	0	0	0
5	0	0	0	⋯	0	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
318	0	0	0	⋯	0	0	0
319	0	0	1	⋯	0	0	0
320	0	1	1	⋯	1	1	0
321	0	0	0	⋯	0	0	0
322	0	0	0	⋯	0	0	0

Mathematical backpropagation calculations with examples of segmentation input are vector-shaped values. Then the hidden layer is 1 with 8 nodes and 8 hidden unit layers [1, 2, 3, 4, 5, 6, 7, 8], then learning rate is used for 0.2 to get the best pattern of the computing system used where the smaller the learning rate value, the error value of MSE will be smaller which will affect the results of classification testing but ignore the activation function and the number of epochs (iterations) specified. The weights used are random values with a range of -1 to 1. For example, the weight of the input layer to the hidden layer as in Table 4.1 and the weights from the hidden layer to the output layer as in Table 4.2.

Table 4.2 Input Layer Weight to Hidden Layer

	Z_1	Z_2	Z_3	Z_4	Z_5
0.00053	0,2	0,3	0,1	-0,1	0,3
-0.00045	0,3	0,2	0,1	0,3	-0,2
0.00153	-0,1	0,2	-0,3	0,3	-0,1
0.1290	-0,3	-0,2	0,2	0,1	0,1
0.14214	0,2	0,3	0,1	-0,2	0,3
0.09405	0,1	-0,3	-0,1	0,2	0,1

0.00068	0,3	0,1	0,3	-0,2	0,3
0.00026	0,2	0,3	0,2	-0,3	-0,1
0.00267	0,1	-0,2	0,2	0,1	0,3
0.19186	-0,3	0,1	-0,2	0,3	-0,2
0.20068	0,2	-0,3	0,1	0,1	-0,3
0.12458	0,1	0,2	-0,3	0,3	0,2
1	-0,1	0,3	-0,1	0,2	-0,3

Table 4.3 Hidden Layer Weight to the Output Layer

	Y
Z_1	0,3
Z_2	0,3
Z_3	0,1
Z_4	-0,2
Z_5	0,2
1	-0,1

In the backpropagation training process, there are three phases namely the advanced propagation phase, backward propagation phase, and weight change phase. Mathematically explained by examples of inputs and weights used in Table 4.1 and Table 4.2.

a) Forward

In this phase, the values of all outputs in the units of the hidden layer are calculated using Equations 2.3 and 2.4. The next step is to calculate the value of all networks or nodes in the output layer unit using equations 2.5 and 2.6. Based on these calculations the output is 1.244 because the value obtained has not met the specified target, because the value obtained does not meet the specified target then the backward propagation process is carried out.

b) Backward

This process is calculated as δ_k which is the error unit of the output layer. Calculations using Equation 2.7 obtained a value of δ_k= 0.3776 which will be used in the weight change of the layer below to correct errors using Equation 2.8. Then the value of δ in the hidden unit layer is calculated with an error in each hidden unit. Z_1 first counts on the network or node in the hidden layer by multiplying the value of δ_k from the output layer with changes in the weights at the output layer. The process can be calculated using equation 2.10. Next, the calculation of the error factor unit in the hidden unit by multiplying the learning rate

(α), the error factor in the hidden unit layer, and the input value. Using equation 2.11. Then the network value or node from the hidden layer is calculated to the input layer by multiplying the learning rate α, the unit error value in the unit layer is hidden and the input value. The equation used is 2.12. the results of these calculations are shown in Table 4.3

Table 4.3 Results of Weight Calculation from the Hidden Layer to the Input Layer

	$\alpha\ \delta_j x_i$		$\alpha\ \delta_j x_i$
Δv_{10}	-0,053	Δv_{17}	-0,00498
Δv_{20}	-0,0302	Δv_{27}	-0,00284
Δv_{30}	-0,0182	Δv_{37}	-0,00171
Δv_{40}	0,0192	Δv_{47}	0,00180
Δv_{50}	-0,0488	Δv_{57}	-0,00458
Δv_{11}	-0,00002	Δv_{18}	-0,00003
Δv_{21}	-0,00001	Δv_{28}	-0,00002
Δv_{31}	-0,000009	Δv_{38}	-0,00001
Δv_{41}	0,00001	Δv_{48}	0,00001
Δv_{51}	-0,00002	Δv_{58}	-0,00003
Δv_{12}	0,00002	Δv_{19}	-0,00001
Δv_{22}	0,00001	Δv_{29}	-0,000007
Δv_{32}	0,000008	Δv_{39}	-0,000004
Δv_{42}	-0,000008	Δv_{49}	0,000004
Δv_{52}	0,00002	Δv_{59}	-0,00001

Δv_{13}	-0,00008	Δv_{110}	-0,00014
Δv_{23}	-0,00004	Δv_{210}	-0,00008
Δv_{33}	-0,00002	Δv_{310}	-0,00004
Δv_{43}	0,00002	Δv_{410}	0,00005
Δv_{53}	-0,00007	Δv_{510}	-0,00013
Δv_{14}	-0,00683	Δv_{111}	-0,01016
Δv_{24}	-0,00389	Δv_{211}	-0,00579
Δv_{34}	-0,00234	Δv_{311}	-0,00349
Δv_{44}	0,00247	Δv_{411}	0,00368
Δv_{54}	-0,00629	Δv_{511}	-0,00936
Δv_{15}	-0,00753	Δv_{112}	-0,01063
Δv_{25}	-0,00429	Δv_{212}	-0,00606
Δv_{35}	-0,00258	Δv_{312}	-0,00365
Δv_{45}	0,00272	Δv_{412}	0,00385
Δv_{55}	-0,00693	Δv_{512}	-0,00979

c) Changes Phase Weight

In the calculated phase changes the new weight of the network or node leading to the output layer unit by adding the weight of the hidden layer network and the weight of the sum of the weights using Equations 2.14 and 2.15 and in Table 4.4.

Table 4.4 New Weight Calculation Table from the Hidden Layer to the Input Layer

	$v_{ji}(old) + \Delta v_{ji}$		$v_{ji}(old) + \Delta v_{ji}$
Δv_{10}	-0,153	Δv_{17}	0,29996
Δv_{20}	0,2698	Δv_{27}	0,09997
Δv_{30}	-0,1182	Δv_{37}	0,29998
Δv_{40}	0,2192	Δv_{47}	-0,19998
Δv_{50}	-0,3488	Δv_{57}	0,29996
Δv_{11}	0,19997	Δv_{18}	0,19998
Δv_{21}	0,29998	Δv_{28}	0,29999
Δv_{31}	0,09999	Δv_{38}	0,19999
Δv_{41}	-0,09998	Δv_{48}	-0,29999
Δv_{51}	0,29997	Δv_{58}	-0,10001
Δv_{12}	0,30002	Δv_{19}	0,09985
Δv_{22}	0,20001	Δv_{29}	0,19991
Δv_{32}	0,100008	Δv_{39}	0,19995
Δv_{42}	0,29999	Δv_{49}	0,10005
Δv_{52}	-0,19997	Δv_{59}	0,29986
Δv_{13}	-0,10008	Δv_{110}	-0,31016
Δv_{23}	0,19995	Δv_{210}	0,09420
Δv_{33}	-0,30002	Δv_{310}	-0,20349
Δv_{43}	0,30002	Δv_{410}	0,30368
Δv_{53}	-0,10007	Δv_{510}	-0,20936
Δv_{14}	-0,30683	Δv_{111}	0,18936
Δv_{24}	-0,20389	Δv_{211}	-0,00579
Δv_{34}	0,19765	Δv_{311}	-0,00349
Δv_{44}	0,10247	Δv_{411}	0,00368
Δv_{54}	0,09370	Δv_{511}	-0,00936

Δv_{15}	0,19246	Δv_{112}	-0,01063
Δv_{25}	0,29570	Δv_{212}	-0,00606
Δv_{35}	0,09741	Δv_{312}	-0,00365
Δv_{45}	-0,19727	Δv_{412}	0,00385
Δv_{55}	0,29306	Δv_{512}	-0,00979
Δv_{16}	0,09501	Δv_{113}	0,09339
Δv_{26}	-0,30284	Δv_{213}	0,19623
Δv_{36}	-0,10171	Δv_{313}	-0,30226
Δv_{46}	0,20180	Δv_{413}	0,30239
Δv_{56}	-0,09541	Δv_{513}	-0,30607

The new weight can be calculated using Equation 2.15. Then after the new weight is obtained, the second iteration is carried out like the above process, namely forward propagation, backward propagation, and renewal of weights until we get the results of a specified pattern or target, for example, target error or iteration.

The backpropagation classification in this study was done computationally using MATLAB R2015a software. Research on breast cancer diagnosis is carried out with 2 types of testing based on the proportion of training and testing data. The distribution of test data is done using k-fold cross-validation. Input data in the form of vectors results from the segmentation process of Hidden Markov Models. Then training and testing are carried out on the test data. The results of the training and testing process with the backpropagation

method obtained an accuracy of 80%, a sensitivity of 84.62% and a specificity of 77.25%.

The best results for the diagnosis of breast cancer using the Hidden Markov Model segmentation which is used as input in the classification process using backpropagation with a hidden layer of 8 nodes, learning rate 0,0007, and MSE error value of 0,0000999. In the backpropagation training process also produces three types of graphs, namely MSE error, training graph, and regression graph. The MSE error graph is shown in Figure 20

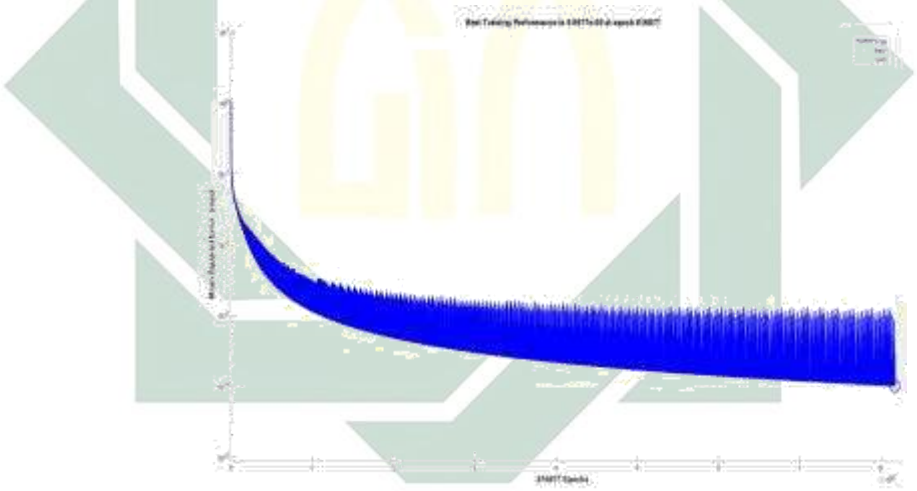


Figure 20 Results of the Error Chart of the Backpropagation Training Process

In Figure 20 shows the error pattern of the data used, if the pattern of the data line keeps going down and sloping which approaches the value of the error target then it produces good pattern recognition so that it will affect the result or output that approaches the actual data value. The training process is carried

out to train programs that are made to be able to do learning with data that has been entered or entered. Then for the training graph shown in Figure 21.

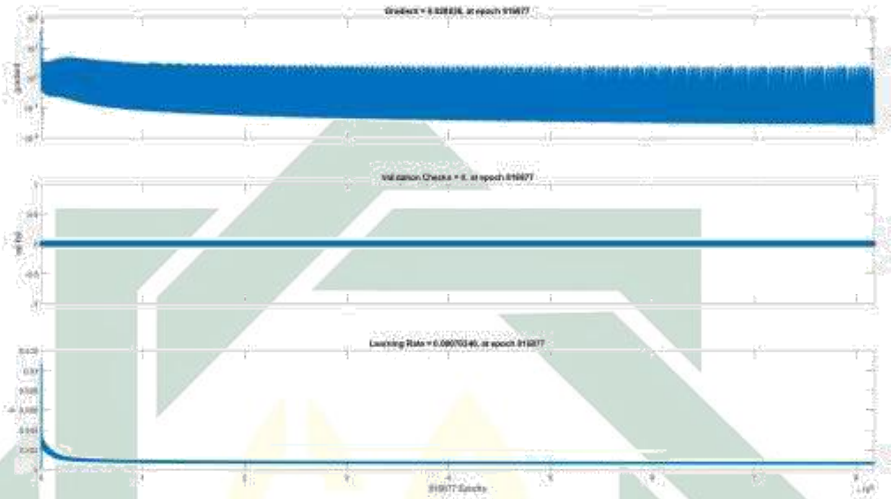


Figure 21 Graph of Backpropagation Training Results

Another analysis is Figure 4.33 which is a training graph consisting of gradient graph, check validation, and learning rate. The gradient graph shows that the line that is getting down and sloping means that the gradient value formed by the system approaches the value of the actual data target. The target is symbolized by a dashed line in Figure 4.33. Graph validation check to check whether the training process is heading in the right direction or even deviating. Then the learning rate graph to see the training level is close to the target value or far away.

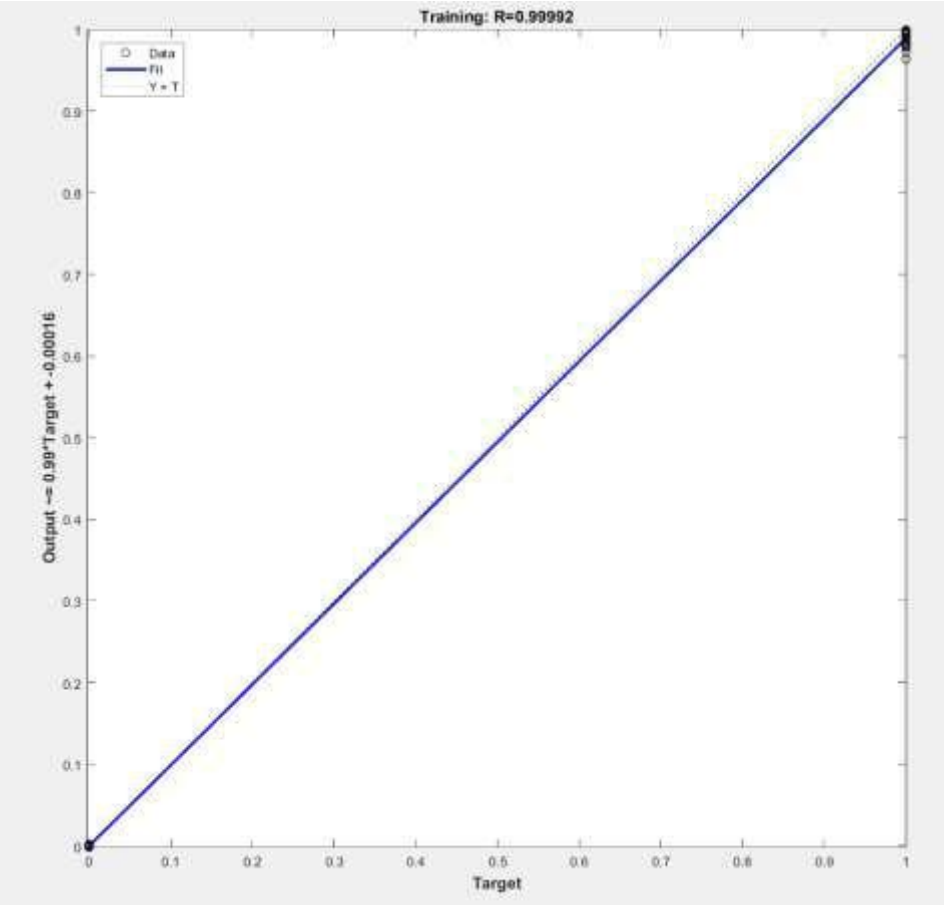


Figure 22 Backpropagation Regression Graph

In Figure 21 shows the gradient value in the training process is 0.02884, the validation checks value is 0, and the learning rate is 0.000704 in the iteration of 816877. Then to strengthen the analysis of the training process can be done on regression charts. Figure 22 shows a good correlation between output data and target data which is equal to 0.9999.

The next process is carried out backpropagation testing with the target category (real data) is 0 and 1. Category 0 states normal and 1 states tumor identification in the brain or glioma. Suppose if the value of

backpropagation output is 0.99887 then it will enter into the category of tumors (glioma). The results of the backpropagation classification are shown in Table 4.9.

Table 4.9 Samples of Backpropagation Classification

Filename (.jpg)	Backpropagation's output	target	Information
normal1	1	1	True
normal2	3	1	False
normal3	1	1	True
normal4	1	1	True
normal5	1	1	True
benign1	2	2	True
benign2	3	2	False
benign3	2	2	True
benign4	2	2	True
malign1	3	3	True
malign2	3	3	True
malign3	3	3	True

The system validation in this study was analyzed using the confusion matrix. The configuration matrix uses measurements by observing sensitivity, specificity, and accuracy.

In this study, the sensitivity value was 84.62%, meaning that patients who had tumors if they tested the diagnosis had an 84.62% chance of having

positive breast cancer. Mathematically it can be calculated using Equation 2.37 and confusion matrix observations.

In the process of classification results obtained a specificity value of 77.25% means that patients who did not suffer from tumors or normal when carrying out diagnostic tests, these patients had a chance of 77.25% normal. Specificity can be calculated using.

In the classification results obtained an accuracy value of 80%, meaning that patients who are normal and have breast cancer if they do a diagnostic test, the patient has the right chance 90% normal and has breast cancer. Accuracy can be calculated using Equation 2.39 and the observation matrix observation in Figure 4.33 which is dividing the right classification results from breast cancer and not having cancer (normal) with the total testing data multiplied by 100%.

CHAPTER 5

CONCLUSION

The conclusion are:

1. The Hidden Markov Model method can be used to segment the MRI image of the brain from the results of image improvement using the Region of Interest and Grayscale. In this study, HMM was used which aims to distinguish between image background and image features. The results of segmentation in the form of vector features will be used as input values from the classification process to identify normal, benign and maligned breasts.
2. Based on the results of image segmentation using HMM and the classification process using Backpropagation for the diagnosis of MRI mammogram images have shown that the best training and testing data is 75% and 25% with a hidden layer of 8 obtained the best accuracy of 80%, sensitivity of 84, 62%, and specificity of 77.25%.

ATTACHMENT

```
clc; clear; close all;
mammo = 'D:\Download\mias-mammography';
form  = dir(fullfile(mammo,'*.pgm'));
n     = numel(form);
for i = 1:n
    file_name = fullfile(mammo, form(i).name);
    imgbm{i}  = imread(file_name);
    imr{i}    = imresize(imgbm{i},0.25);
    posisi{i} = posisi{i}(:,:)./4;
    roitb{i}  =
roipoly(imr{i},posisi{i}(:,1),posisi{i}(:,2));
    img{i}    =
regionfill(imr{i},imcomplement(roitb{i}));
    OutName   = sprintf('ImageCrop #%d.pgm', i);
    folderName= fullfile(mammo, OutName);
    imwrite(img{i}, folderName);
end


image_folder = 'train\N';
filenames = dir(fullfile(image_folder, '*.pgm'));
total_images = numel(filenames);
image_folder1 = 'train\M';
filenames1 = dir(fullfile(image_folder1, '*.pgm'));
kabeh = [filenames; filenames1];
total_images1 = numel(kabeh);
image_folder2 = 'train\B'
filenames2 = dir(fullfile(image_folder2, '*.pgm'));
kabeh1 = [filenames; filenames1; filenames2];
total_images2 = numel(kabeh1);

for n = 1:total_images2
    if n<=total_images
        i=n;
       full_name = fullfile(image_folder,
filenames(i).name);
    elseif n <= total_images1
        i=n-total_images;
       full_name = fullfile(image_folder1,
filenames1(i).name);
    else
```

```
        i=n-total_images1;
       full_name = fullfile(image_folder2,
filenames2(i).name);
    end
end


haha   = fullfile(image_folder1, filenames1(11).name);
gambar = imread(haha); figure;
imshow(gambar);title('mammogram image');
grayim = rgb2gray(gambar);figure;
imshow(gambar);title('gray scale image')
clahe  = adapthisteq(grayim);figure;
imshow(clahe);title('Adaptive Histogram Equalization')
pembagi= double(grayim)*(1/256);
    [o p] = size(pembagi);
    T1 = 0.75;
    T2 = 0.96; % thresholds

    for i = 1:o
        for j = 1:p
            if pembagi(i,j)>T1 && pembagi(i,j)<T2
                original(i,j)=0; %changes to white image
            else
                original(i,j)=1; %changes to white black
            end
        end
    end
    hasil_treshold=imcomplement(original); figure;
imshow(hasil_treshold);title('Thresholding')

    %%klasifikasi
    j = 0;
    for k = 1:p
        P(n,(j*p)+1:(p*k)) = hasil_treshold(k,:);
        j=j+1;
    end

%%P adalah inputan, T adalah target
T(1:total_images,1) = [1];
T(total_images+1:total_images1,1) = [2];
T(total_images1+1:total_images2,1) = [3];
save hasilpre.mat P T
```

```
load hasilpre.mat P T

[Path,Xi] = hmmdecode(P,T,hmm,type,residuals,preproc)
if isstruct(data)
    if isfield(data,'C') && ~all(isnan(data.C(:)))
        warning('Pre-specified state time courses will be
ignored for Viterbi path calculation')
    end
    data = data.X;
end

Xi = [];

K = length(hmm.state);

if isempty(residuals)
    if ~isfield(hmm.train,'Sind')
        orders =
formorders(hmm.train.order,hmm.train.orderoffset,hmm.trai
n.timelag,hmm.train.exptimelag);
        hmm.train.Sind = formindexes(orders,hmm.train.S);
    end
    residuals =
getresiduals(data,T,hmm.train.Sind,hmm.train.maxorder,hmm
.train.order,...

hmm.train.orderoffset,hmm.train.timelag,hmm.train.exptime
lag,hmm.train.zeromean);
end

if ~isfield(hmm,'P')
    hmm = hmmhsinit(hmm);
end

order = hmm.train.maxorder;

if hmm.train.useParallel==1 && N>1

    Path = cell(N,1);

    parfor n = 1:N

      P = hmm.P; Pi = hmm.Pi;

        q_star = ones(T(n)-order,1);
```

```
        scale=zeros(T(n),1);
        alpha=zeros(T(n),K);
        beta=zeros(T(n),K);

        % Initialise Viterbi bits
        delta=zeros(T(n),K);
        psi=zeros(T(n),K);

        if n==1, t0 = 0; s0 = 0;
        else t0 = sum(T(1:n-1)); s0 = t0 - order*(n-1);
        end

        B =
obslike(data(t0+1:t0+T(n),:),hmm,residuals(s0+1:s0+T(n)-
order,:));
        B(B<realmin) = realmin;

        % Scaling for delta
        dscale=zeros(T(n),1);

        alpha(1+order,:)=Pi(:)'.*B(1+order,:);
        scale(1+order)=sum(alpha(1+order,:));

alpha(1+order,:)=alpha(1+order,:)/(scale(1+order));

        delta(1+order,:) = alpha(1+order,:);    % Eq.
32(a) Rabiner (1989)
        % Eq. 32(b) Psi already zero
        for i=2+order:T(n)
            alpha(i,:)=(alpha(i-1,:)*P).*B(i,:);
            scale(i)=sum(alpha(i,:));
            if scale(i)<realmin, scale(i) = realmin; end
            alpha(i,:)=alpha(i,:)/(scale(i));

            for k=1:K
                v=delta(i-1,:).*P(:,k)';
                mv=max(v);
                delta(i,k)=mv*B(i,k);  % Eq 33a Rabiner
(1989)
                fmv = find(v==mv);
                if length(fmv) > 1
                    % no unique maximum - so pick one at
random
                    tmp1=fmv;
```

```
                    tmp2=rand(length(tmp1),1);
                    [~,tmp4]=max(tmp2);
                    psi(i,k)=tmp4;
                else
                    psi(i,k)=fmv;  % ARGMAX; Eq 33b
Rabiner (1989)
                end
            end

            % SCALING FOR DELTA ????
            dscale(i)=sum(delta(i,:));
            if dscale(i)<realmin, dscale(i) = realmin;
end
            delta(i,:)=delta(i,:)/(dscale(i));
        end

        % Get beta values for single state decoding
        beta(T(n),:)=ones(1,K)/scale(T(n));
        for i=T(n)-1:-1:1+order

beta(i,:)=(beta(i+1,:).*B(i+1,:))*(P')/scale(i);
        end

        xi=zeros(T(n)-1-order,K*K);
        for i=1+order:T(n)-1
            t=P.*( alpha(i,:)' *
(beta(i+1,:).*B(i+1,:)));
            xi(i-order,:)=t(:)'/sum(t(:));
        end

        delta=delta(1+order:T(n),:);
        psi=psi(1+order:T(n),:);

        % Backtracking for Viterbi decoding
        id = find(delta(T(n)-order,:)==max(delta(T(n)-
order,:)));% Eq 34b Rabiner;
        q_star(T(n)-order) = id(1);
        for i=T(n)-1-order:-1:1
            q_star(i) = psi(i+1,q_star(i+1));
        end

        Path{n} = single(q_star);

    end
```

```
    Path = cell2mat(Path);

else

    Path = zeros(sum(T)-length(T)*order,1,'single');
    tacc = 0;

    for n=1:N

        %if Q > 1
        %    i = grouping(n);
        %    P = hmm.P(:,:,i); Pi = hmm.Pi(:,i)';
        %else
        %    P = hmm.P; Pi = hmm.Pi;
        %end
        P = hmm.P; Pi = hmm.Pi;

        q_star = ones(T(n)-order,1);

        alpha=zeros(T(n),K);
        beta=zeros(T(n),K);

        % Initialise Viterbi bits
        delta=zeros(T(n),K);
        psi=zeros(T(n),K);

        if n==1, t0 = 0; s0 = 0;
        else t0 = sum(T(1:n-1)); s0 = t0 - order*(n-1);
        end

        B =
obslike(data(t0+1:t0+T(n),:),hmm,residuals(s0+1:s0+T(n)-
order,:));
        B(B<realmin) = realmin;

        scale=zeros(T(n),1);
        % Scaling for delta
        dscale=zeros(T(n),1);

        alpha(1+order,:)=Pi(:)'.*B(1+order,:);
        scale(1+order)=sum(alpha(1+order,:));


alpha(1+order,:)=alpha(1+order,:)/(scale(1+order)+realmin
);
```

```
        delta(1+order,:) = alpha(1+order,:);     % Eq.
32(a) Rabiner (1989)
        % Eq. 32(b) Psi already zero
        for i=2+order:T(n)
            alpha(i,:)=(alpha(i-1,:)*P).*B(i,:);
            scale(i)=sum(alpha(i,:));
            alpha(i,:)=alpha(i,:)/(scale(i)+realmin);

            for k=1:K
                v=delta(i-1,:).*P(:,k)';
                mv=max(v);
                delta(i,k)=mv*B(i,k);  % Eq 33a Rabiner
(1989)
                if length(find(v==mv)) > 1
                    % no unique maximum - so pick one at
random

                    tmp1=find(v==mv);
                    tmp2=rand(length(tmp1),1);
                    [~,tmp4]=max(tmp2);
                    psi(i,k)=tmp4;
                else
                    psi(i,k)=find(v==mv);  % ARGMAX; Eq
33b Rabiner (1989)
                end
            end

            % SCALING FOR DELTA ????
            dscale(i)=sum(delta(i,:));
            delta(i,:)=delta(i,:)/(dscale(i)+realmin);
        end

        % Get beta values for single state decoding
        beta(T(n),:)=ones(1,K)/scale(T(n));
        for i=T(n)-1:-1:1+order

beta(i,:)=(beta(i+1,:).*B(i+1,:))*(P')/scale(i);
        end

        xi=zeros(T(n)-1-order,K*K);
        for i=1+order:T(n)-1
            t=P.*( alpha(i,:)' *
(beta(i+1,:).*B(i+1,:)));
            xi(i-order,:)=t(:)'/sum(t(:));
        end
```

```
        delta=delta(1+order:T(n),:);
        psi=psi(1+order:T(n),:);

        % Backtracking for Viterbi decoding
        id = find(delta(T(n)-order,:)==max(delta(T(n)-
order,:)));% Eq 34b Rabiner;
        q_star(T(n)-order) = id(1);
        for i=T(n)-1-order:-1:1
            q_star(i) = psi(i+1,q_star(i+1));
        end

        Path( (1:(T(n)-order)) + tacc ) = q_star;
        tacc = tacc + T(n)-order;

    end

end

end


fprintf('training dimulai\n')
 JumPola    = length(X(:,1));
  DimPola    = length(X(1,:));

  [a,b] = size(T)
  for i = 1:a
      if T(i,1) == 1
          T(i,1) = 0.001;
      else
          T(i,1) = 0.999;
      end
  end
  JOneuron  = length(T(1,:));

  JHneuron1 = 80;
  LR = 0.4;
  Epoch = 2000;
  MaxMSE = 0.001;



  % ------------------------------------------------
--------
```

```
  % Bangkitkan Weights antara Input dan Hidden Layer
secara acak
  % ------------------------------------------------------
--------
  CB = 0.5;
  LD = 0.0001;
  E3 = 0.1;
  JHneuron2 = 40;

  Skala = 0.7 * (JHneuron1^(1 / DimPola ));
  W1 = (-0.5) + (0.5 - (-
0.5)).*rand(JHneuron1,DimPola);W1 = W1';
  % ==== inisialisasi nguyen-widrow ====
  VH = zeros(JHneuron1,1);
  for i=1:JHneuron1
      VH(i) = norm( W1(:,i));
  end

  W1 = Skala * W1;
  for i=1:JHneuron1
      W1(:,i) = W1(:,i)/VH(i);
  end
  % ====================================
  B1 = ((-1) * Skala) + (Skala - (((-1) *
Skala))).*rand(1,JHneuron1);

  W2 = (-0.5) + (0.5 - (-
0.5)).*rand(JHneuron2,JHneuron1); W2 = W2';
  B2 = (-0.5) + (0.5 - (-0.5)).*rand(1,JHneuron2);

  W3 = (-0.5) + (0.5 - (-0.5)).*rand(JOneuron,JHneuron2);
W3 = W3';
  B3 = (-0.5) + (0.5 - (-0.5)).*rand(1,JOneuron);

  MSEepoch = MaxMSE + 1;
  MSE = zeros(1,Epoch);
  ee = 0;
  fprintf('masuk perulangan\n')
  while (ee < Epoch) && (MSEepoch > MaxMSE)

      ee = ee + 1;
      %MSE_NonLinear = 0;
      MSE_Linear = 0;

      % choose neighborhood
```

```
        ch_nei = floor(rand(1) * 2);

        for pp=1:JumPola

            CP = P(pp,:);
            CT = T(pp,:);

            % feedforward
            Z1 = zeros(1,JHneuron1);
            for i= 1:JHneuron1
                Z1(i) = tansig( CB * B1(:,i) + CP * W1(:,i)
);
            end

            Z2 = zeros(1,JHneuron2);
            for i= 1:JHneuron2
                Z2(i) = tansig( CB * B2(:,i) + Z1 * W2(:,i)
);
            end

            Y = zeros(1,JOneuron);
            Y_in = zeros(1,JOneuron);
            for i= 1:JOneuron
                Y_in(i) = CB * B3(:,i) + Z2 * W3(:,i);
                Y(i) = logsig( Y_in(i) );
            end

            % perhitungan nonlinear and linear error
            e1_o = CT - Y;                          %
nonlinear error
            e2_o = ( log(CT)-log(1-CT) ) - Y_in; % linear
error

            for i=1:JOneuron
                %MSE_NonLinear = MSE_NonLinear + e1_o(i)^2;
                MSE_Linear    = MSE_Linear + e2_o(i)^2;
            end
            %MSE_NonLinear = 0.5 * MSE_NonLinear;
            %MSE_Linear = 0.5 * LD * MSE_Linear;
            MSE_Linear = 0.5 * MSE_Linear;

            % backpropagation of error

            if (ch_nei == 0)
                nh1_a = 1;
```

```
                nh1_b = floor(JHneuron1/2) - 1;
                nh2_a = 1;
                nh2_b = floor(JHneuron2/2) - 1;
            else
                nh1_a = floor(JHneuron1/2);
                nh1_b = JHneuron1;
                nh2_a = floor(JHneuron2/2);
                nh2_b = JHneuron2;
            end
            fprintf('masuk hidden layer dan output\n')
            % ========== hidden - output
================================

            dk1_o = zeros(1,JOneuron);
            for i = 1:JOneuron
                dk1_o(i) = e1_o(i) * Y(i) * (1 - Y(i));
            end

            dW3 = zeros(JHneuron2,JOneuron);
            delta3 = zeros(1,JOneuron);
            for i = nh2_a:nh2_b
                for j = 1:JOneuron
                    adf = norm( Y(j) * (1 - Y(j)) * Z2(i) *
e1_o(j) )^2 + E3;
                    delta3(j) = (1/adf) * ((LR *
norm(e1_o(j))^2) * dk1_o(j) * Z2(i) + LD * e2_o(j) *
Z2(i) );
                end
                dW3(i,:) = delta3;
            end

            bias3 = zeros(1,JOneuron);
            for i = 1:JOneuron
                adf = norm( Y(i) * (1 - Y(i)) * CB *
e1_o(i)  )^2 + E3;
                bias3(i) = (1/adf) * ((LR *
norm(e1_o(i))^2) * dk1_o(i) * CB + LD * e2_o(i) * CB);
            end
            dB3 = bias3;
            fprintf('layer hidden 1\n')
            % ========== Layer Hidden 2
================================
            e1_h2 = zeros(1,JHneuron2);
            e2_h2 = e1_h2;
            for i = nh2_a:nh2_b
```

```
                dd = 0.5 * (1+Z2(i)) * (1-Z2(i));
                e1_h2(i) = dd * dk1_o * W3(i,:)';
                e2_h2(i) = dd * e2_o * W3(i,:)';
            end

            dW2 = zeros(JHneuron1,JHneuron2);
            delta2 = zeros(1,JHneuron2);
            for i = nh1_a:nh1_b
                for j = nh2_a:nh2_b
                    adf = norm( 0.5 * (1+Z2(j)) * (1-Z2(j))
* Z1(i) * e1_h2(j)  )^2 + E3;
                    delta2(j) = (1/adf) * ((LR *
norm(e1_h2(j))^2) * Z1(i) * e1_h2(j) + LD * Z1(i) *
e2_h2(j));
                end
                dW2(i,:) = delta2;
            end

            bias2 = zeros(1,JHneuron2);
            for i = nh2_a:nh2_b
                adf = norm( 0.5 * (1+Z2(j)) * (1-Z2(j)) *
CB * e1_h2(j)  )^2 + E3;
                bias2(i) = (1/adf) * ((LR *
norm(e1_h2(j))^2) * e1_h2(i) * CB + LD * e2_h2(i) * CB);
            end
            dB2 = bias2;
            fprintf('hidden layer 2')
            % ========== Layer Hidden 1
================================
            e1_h1 = zeros(1,JHneuron1);
            e2_h1 = e1_h1;
            for i = nh1_a:nh1_b
                dd = 0.5 * (1+Z1(i)) * (1-Z1(i));
                e1_h1(i) = dd * e1_h2 * W2(i,:)';
                e2_h1(i) = dd * e2_h2 * W2(i,:)';
            end

            dW1 = zeros(DimPola,JHneuron1);
            delta1 = zeros(1,JHneuron1);
            for i = 1:DimPola
                for j = nh1_a:nh1_b
                    adf = norm( 0.5 * (1+Z1(j)) * (1-Z1(j))
* CP(i) * e1_h1(j)  )^2 + E3;
```

```
                    delta1(j) = (1/adf) * ((LR *
norm(e1_h1(j))^2) * CP(i) * e1_h1(j) + LD * CP(i) *
e2_h1(j));
                end
                dW1(i,:) = delta1;
            end

            bias1 = zeros(1,JHneuron1);
            for i = nh1_a:nh1_b
                adf = norm( 0.5 * (1+Z1(j)) * (1-Z1(j)) *
CB * e1_h1(j)  )^2 + E3;
                bias1(i) = (1/adf) * ((LR *
norm(e1_h1(j))^2) * e1_h1(i) * CB + LD * e2_h1(i) * CB);
            end
            dB1 = bias1;
            fprintf('perhitungan bobot dan bias\n')
            W1 = W1 + dW1;
            W2 = W2 + dW2;
            W3 = W3 + dW3;
            B1 = B1 + dB1;
            B2 = B2 + dB2;
            B3 = B3 + dB3;

        end % end for pp
        fprintf('perulangan baru\n')
        MSEepoch = (MSE_Linear/JumPola);
        %disp(['Epoch = ', num2str(ee), ' => Neighborhood-
', num2str(ch_nei), ' MSE = ', num2str(MSEepoch)]);
        disp(['Epoch = ', num2str(ee), ' =>  MSE = ',
num2str(MSEepoch)]);
        MSE(ee) = MSEepoch;
    end % end while

    toc;
    if (MSE(ee) > MaxMSE)
        disp('Maximum epoch reached, performance goal was
not met.');
    else
        disp(['Performance goal met. Epoch = ',
num2str(ee)]);
    end

    i=1:length( MSE(:,1:ee) );
    j=1:0.1:length( MSE(:,1:ee) );
    plot(i, MSE(:,1:ee), 'rs-',j,MaxMSE,'b-',i,-0.01);
```

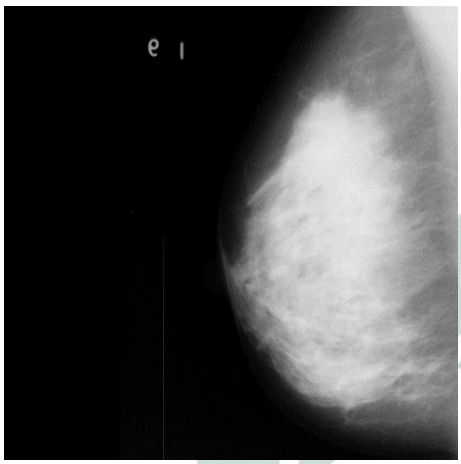
```
  xlabel([num2str(ee), ' Epochs']);
  ylabel('Mean Squared Error (mse)');
  title(['NMBP w/ Adaptive Learning, Perf is ',
num2str(MSEepoch), ', Goal is ', num2str(MaxMSE)]);
  legend('Training','Goal');
  save TResult.mat CB W1 W2 W3 B1 B2 B3 JHneuron1
JHneuron2 JOneuron;

fileSave = ['Grafik _' datestr(now,'yyyymmdd-HHMM')];

save(fileSave);

%save gambar
saveas(gcf,fileSave,'png');

fprintf('simpan grafik sebagai: %s \n',fileSave);



% feedforward
      Z1 = zeros(1,JHneuron1);
      for i= 1:JHneuron1
          Z1(i) = tansig( CB * B1(:,i) + CP * W1(:,i) );
      end

      Z2 = zeros(1,JHneuron2);
      for i= 1:JHneuron2
          Z2(i) = tansig( CB * B2(:,i) + Z1 * W2(:,i) );
      end

      Y = zeros(1,JOneuron);
      Y_in = zeros(1,JOneuron);
      for i= 1:JOneuron
          Y_in(i) = CB * B3(:,i) + Z2 * W3(:,i);
          Y(i) = logsig( Y_in(i) );
      end

      if (Y < 0.5)
          if (nn > 4)
              %bb = ((0.999-0.001)-abs(0.999-Y))*100;
              %dd = dd + bb;
              %A1 = A1 + bb;
              K1 = K1 + 1 ;
```

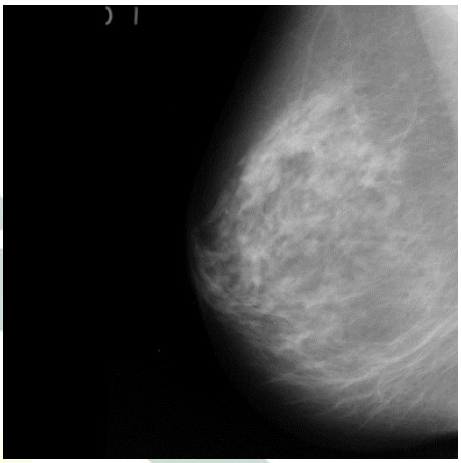
```
                %disp(['*** File : ',ff,' =>
Microclasification Jinak salah dikenali, Validitas = ',
num2str(bb), '%']);
                 disp(['*** File : ',ff,' =>
Mikroklasifikasi Jinak salah dikenali ']);
            else
                cc = cc + 1;
                %bb = ((0.999-0.001)-abs(CT-Y))*100;
                %dd = dd + bb;
                %A2 = A2 + bb;
                J1 = J1 + 1;
                K1 = K1 + 1;
                %disp(['File : ',ff,' => Microclasification
Jinak dikenali, Validitas = ', num2str(bb), '%']);
                disp(['*** File : ',ff,' =>
Mikroklasifikasi Jinak dikenali']);
            end

        elseif (Y > 0.5)
            if (nn <= 4)
                %bb = ((0.999-0.001)-abs(0.001-Y))*100;
                %dd = dd + bb;
                %A3 = A3 + bb;
                K2= K2 + 1;
                %disp(['*** File : ',ff,' =>
Microclasification Ganas salah dikenali, Validitas = ',
num2str(bb), '%']);
                disp(['*** File : ',ff,' =>
Mikroklasifikasi Ganas salah dikenali ']);
            else
                cc = cc + 1;
                %bb = ((0.999-0.001)-abs(CT-Y))*100;
                %dd = dd + bb;
                %A4 = A4 + bb;
                J2 = J2 + 1;
                K2 = K2 + 1;
                %disp(['File : ',ff,' => Microclasification
Ganas dikenali, Validitas = ', num2str(bb), '%']);
                disp(['*** File : ',ff,' =>
Mikroklasifikasi Ganas dikenali ']);

            end

        else
           %bb = ((0.999-0.001)-abs(CT-Y))*100;
```

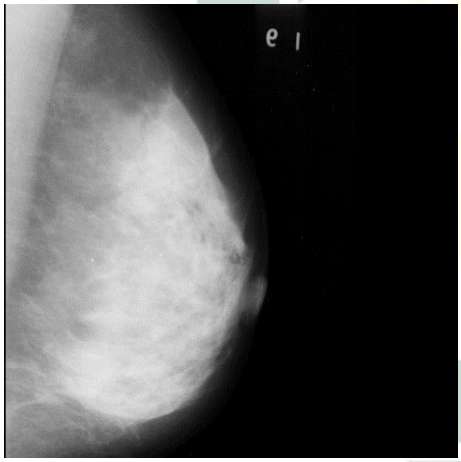
```
            %dd = dd + bb;
            %A5 = A5 + bb;
            %disp(['*** File : ',ff,' => Microclasification
salah dikenali, Validitas = ', num2str(bb), '%']);
            K3 = K3 + 1;
            disp(['*** File : ',ff,' => Mikroklasifikasi
salah dikenali']);

        end
    end

    akurasiJinak = (J1*100)/4 ;
    akurasiGanas = (J2*100)/4 ;
    disp(' ');
    %disp(['Jumlah Pola Semua= ', num2str(Test_Number), ',
Dikenali = ', num2str(cc), ', Validitas = ', num2str(
dd/Test_Number ),',Akurasi = ', num2str(
(cc*100)/Test_Number ), '%']);
    %disp(['Jumlah Pola Microclasification Jinak = ',
num2str(4), ', Dikenali Microclasifikasi Jinak = ',
num2str(J1)]);
    %disp(['Microclasification Jinak --> Validitas = ',
num2str( A2/4 ), ', Akurasi = ', num2str( (J1*100)/4 ),
'%']);
    %disp(['Jumlah Pola Microclasification Ganas= ',
num2str(4), ', Dikenali Microclasification Ganas = ',
num2str(J2)]);
    %disp(['Microclasification Ganas --> Validitas = ',
num2str( A4/4 ), ', Akurasi = ', num2str( (J2*100)/4
),'%']);
    %disp(['Average = ', num2str(
(((J1*100)/4)+((J2*100)/4))/2 ), '%']);

    disp(['Jumlah Pola Semua= ', num2str(Test_Number), ' =>
Mikroklasifikasi Jinak = ', num2str(K1), ',
Mikroklasifikasi Ganas = ', num2str(K2)]);
    disp(['Dikenali = ', num2str(cc), ' => Dikenali
Mikroklasifikasi Jinak = ', num2str(J1), ', Dikenali
Mikroklasifikasi Ganas = ', num2str(J2)]);
    disp(['Jumlah Pola Mikroklasifikasi Jinak = ',
num2str(4), ', Akurasi = ', num2str(akurasiJinak), '%']);
    disp(['Jumlah Pola Mikroklasifikasi Ganas = ',
num2str(4), ', Akurasi = ', num2str(akurasiGanas),'%']);
```

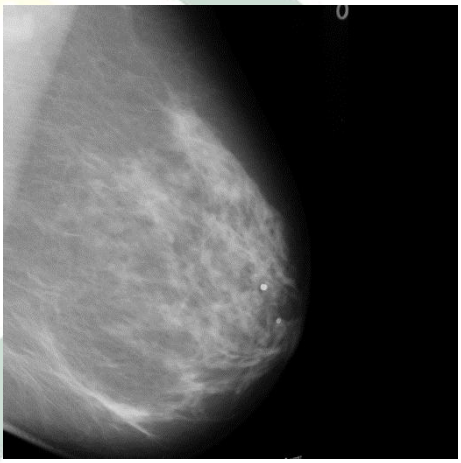
```
%simpan variabel hasil
fileSave = ['hasil _' num2str(akurasiJinak) '_'
num2str(akurasiGanas) '_' datestr(now,'yyyymmdd-HHMM')];

save(fileSave);

%save gambar
fprintf('simpan hasil sebagai: %s \n',fileSave);
```

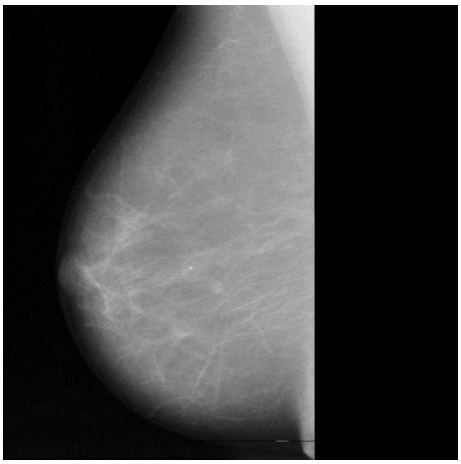
DATASET IMAGE

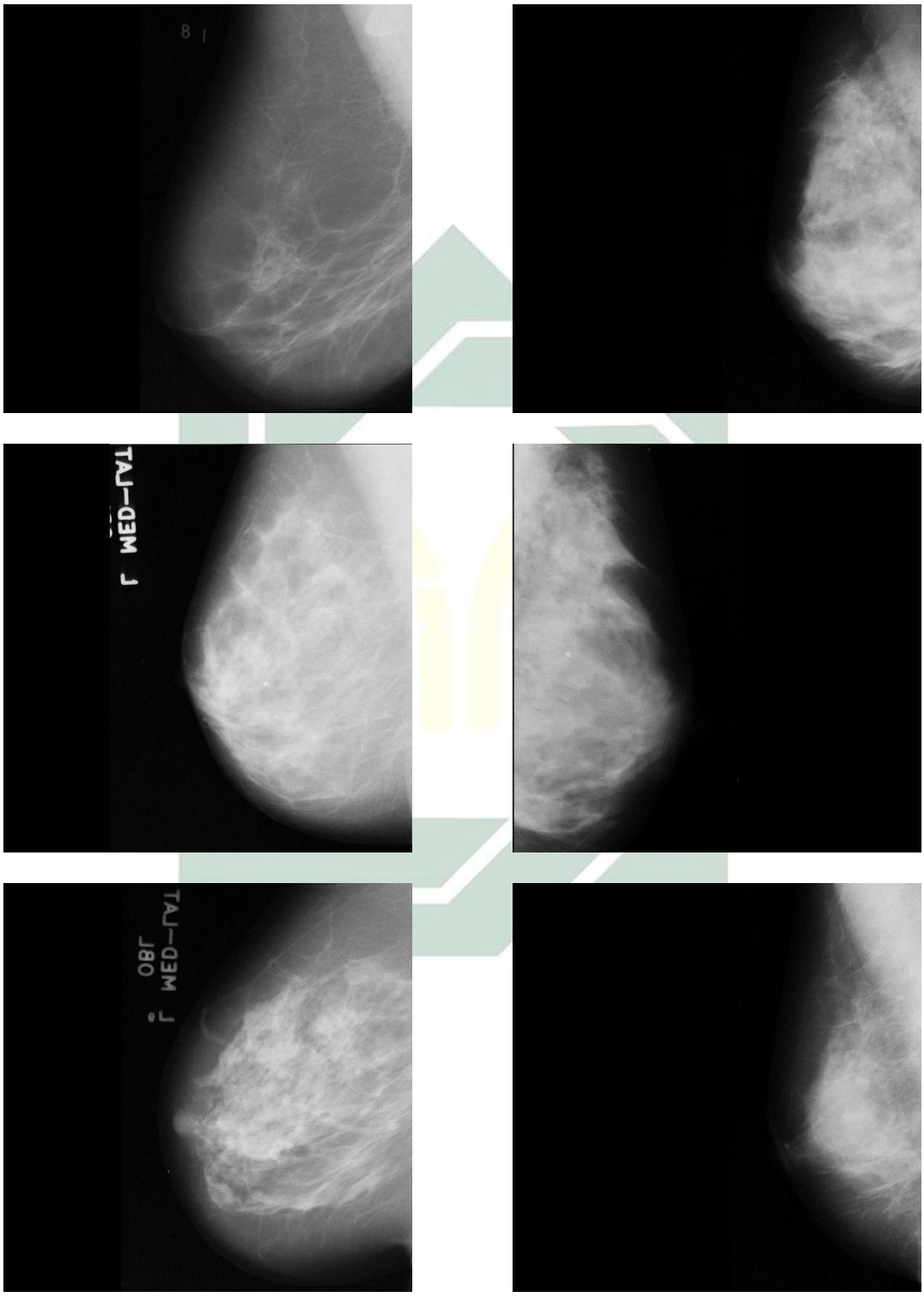


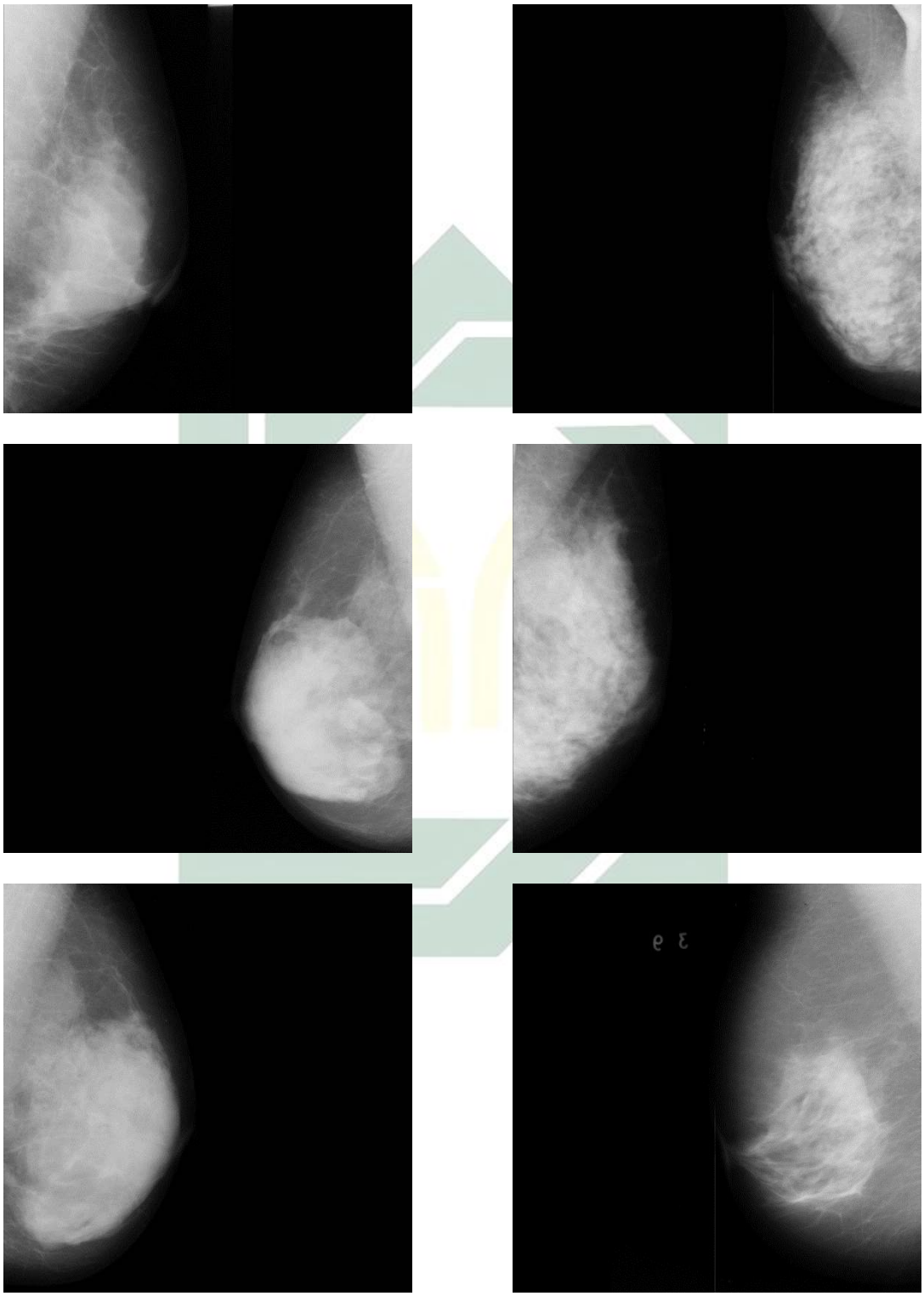


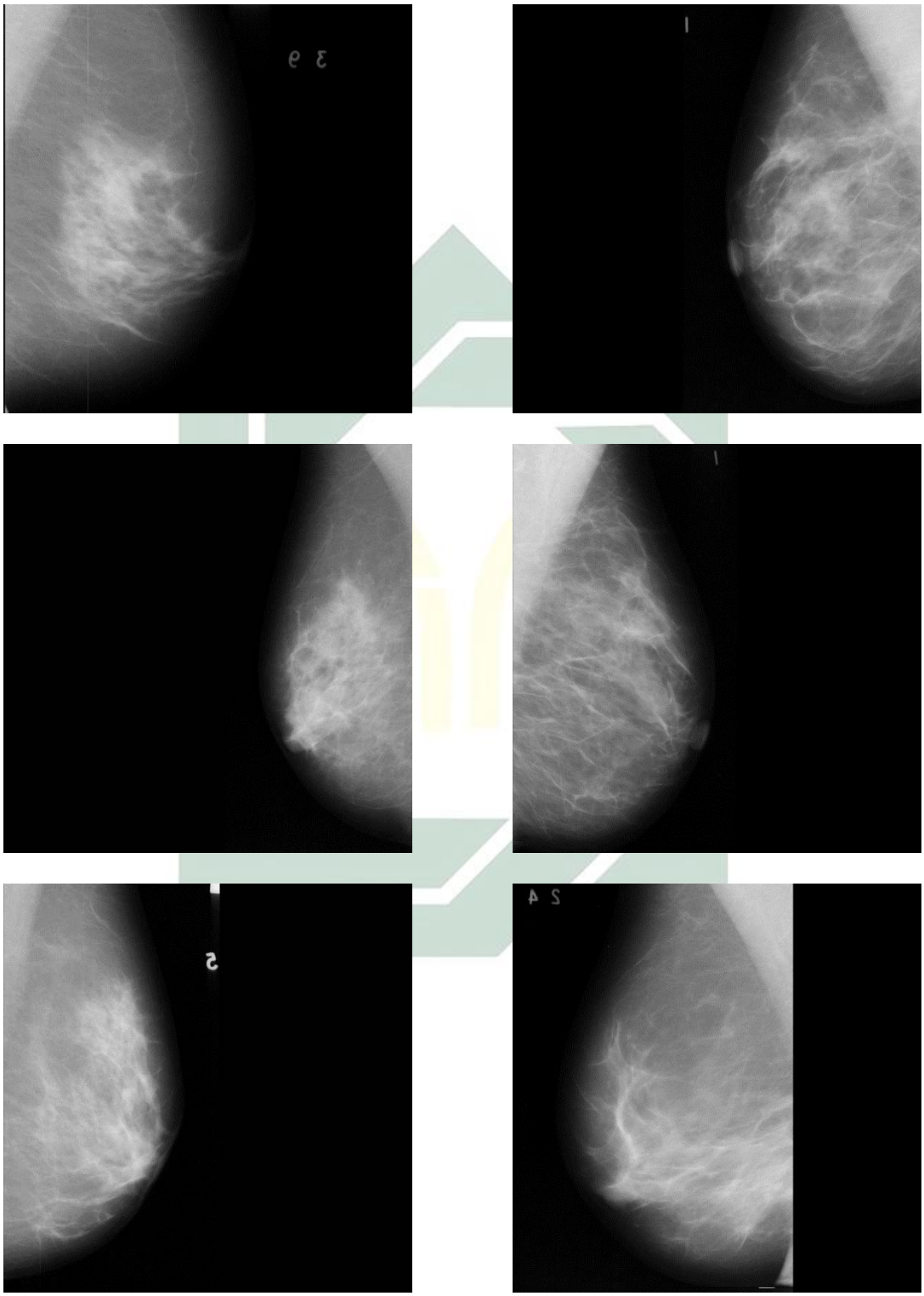


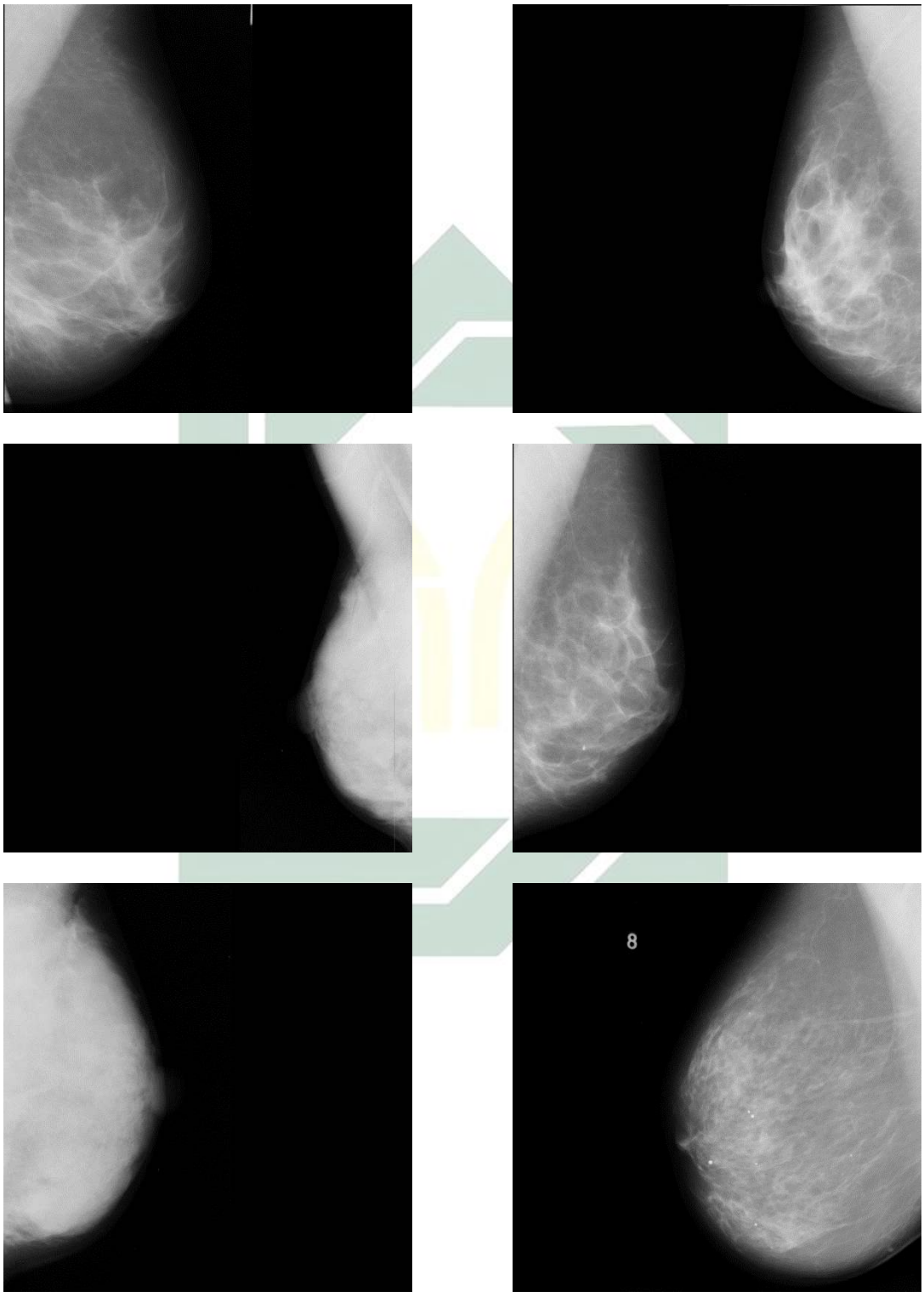


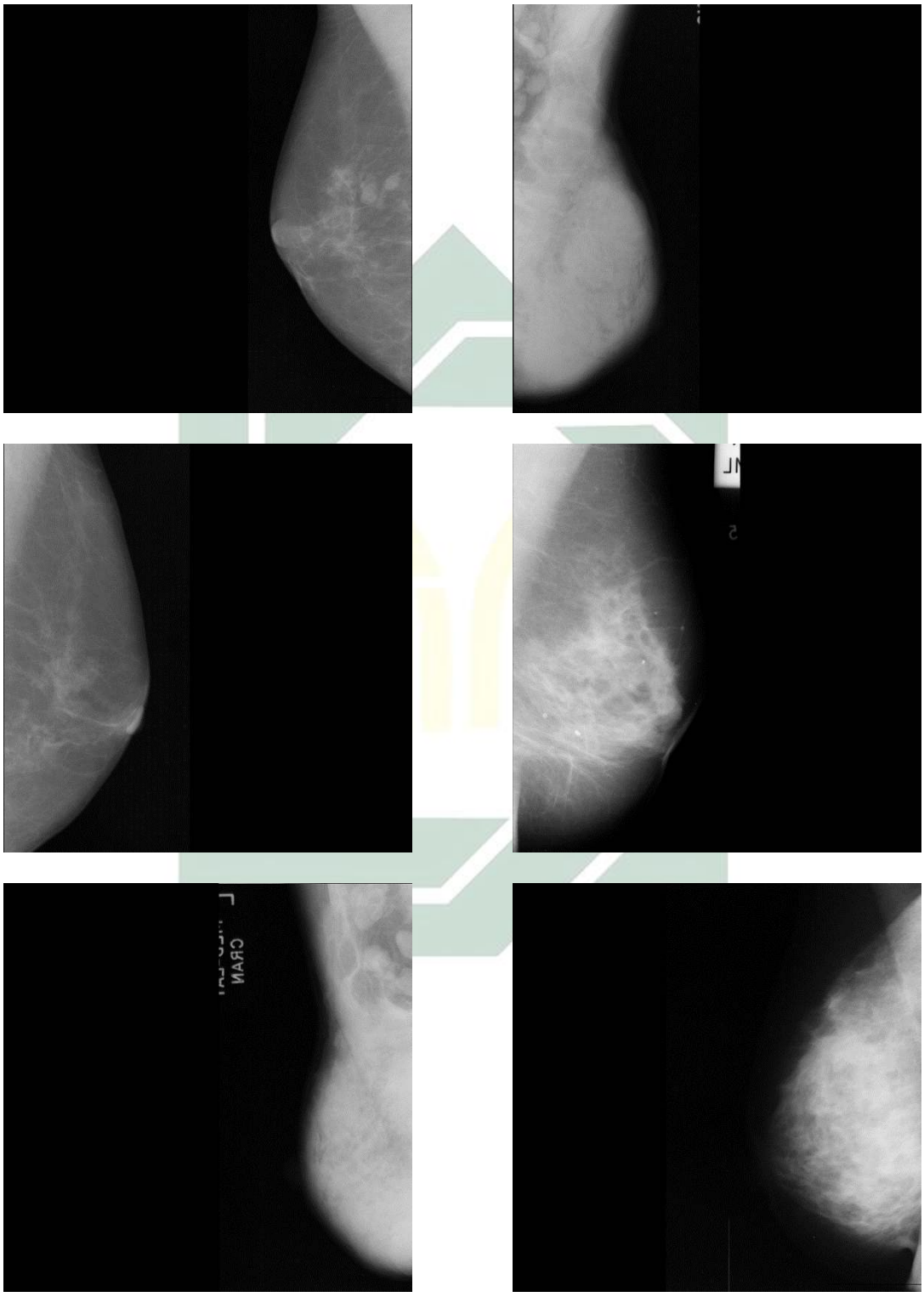


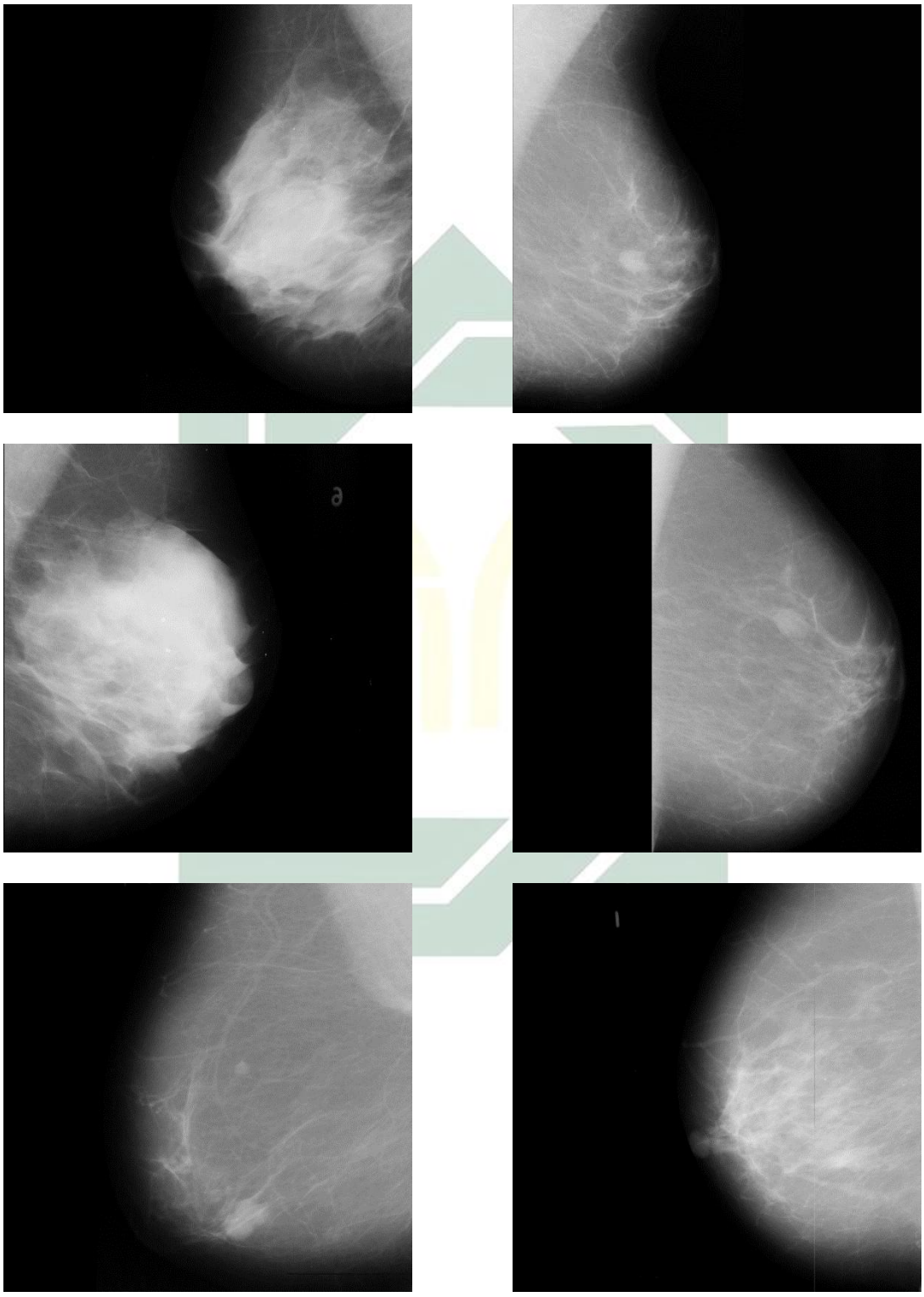


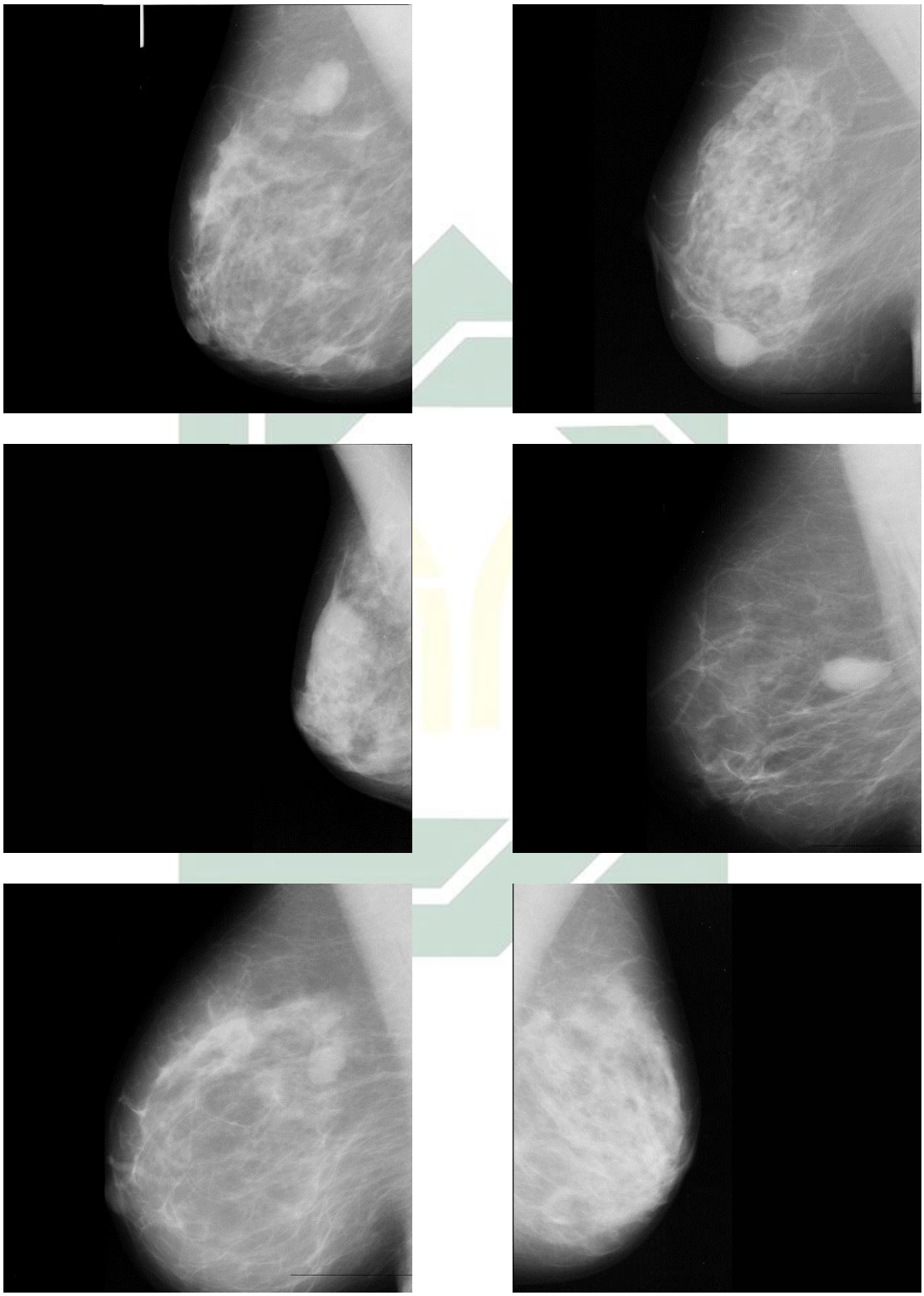


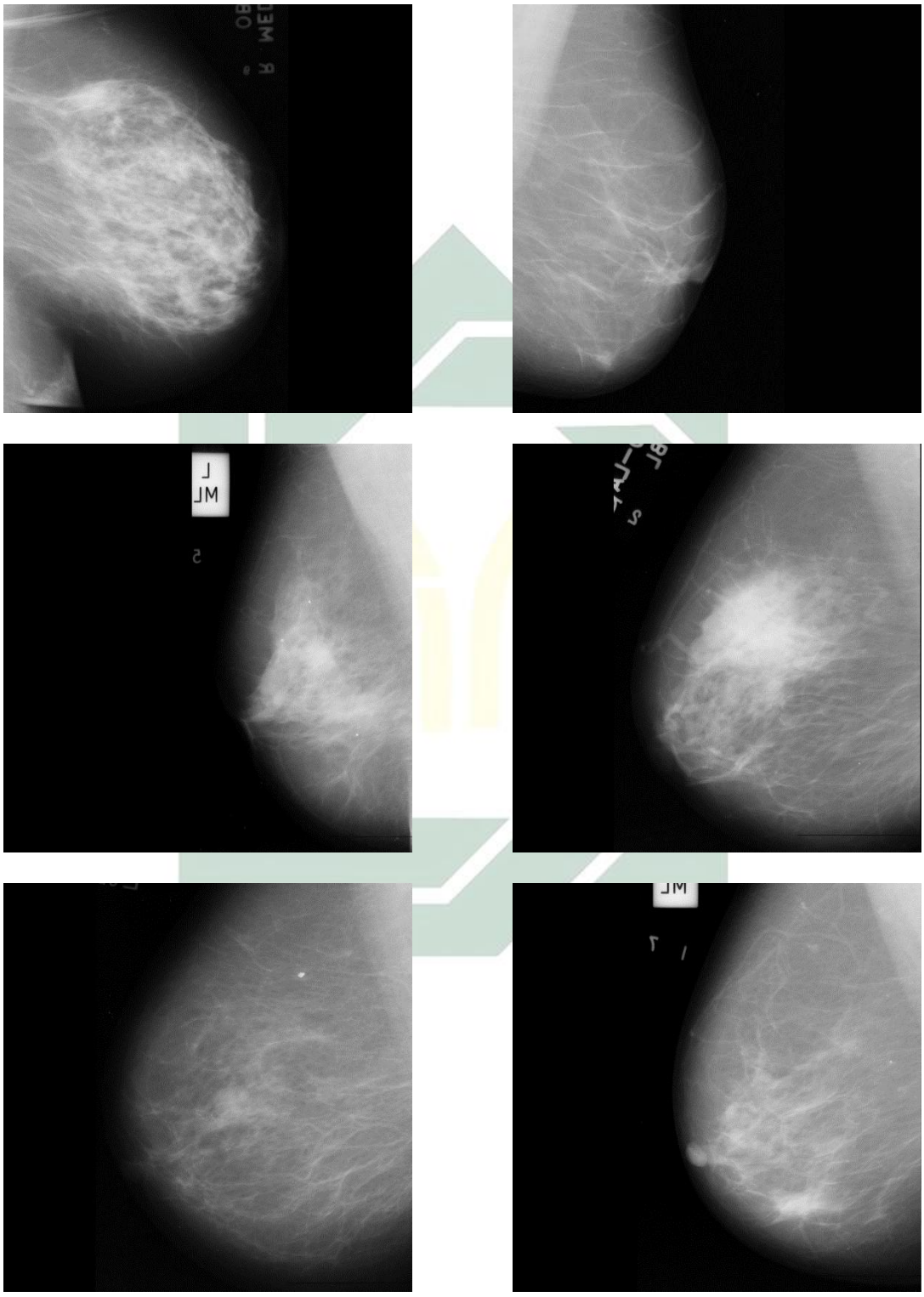


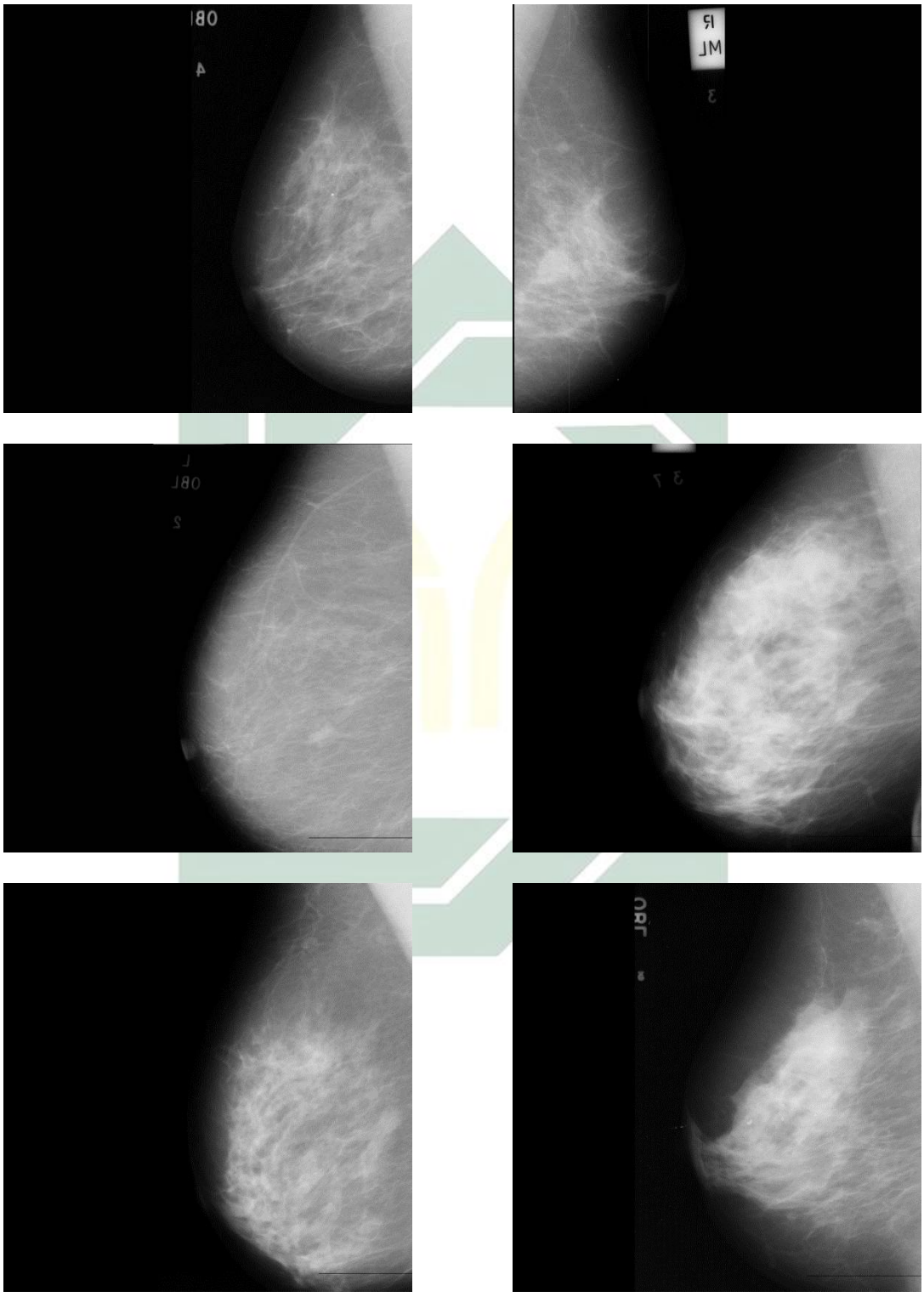


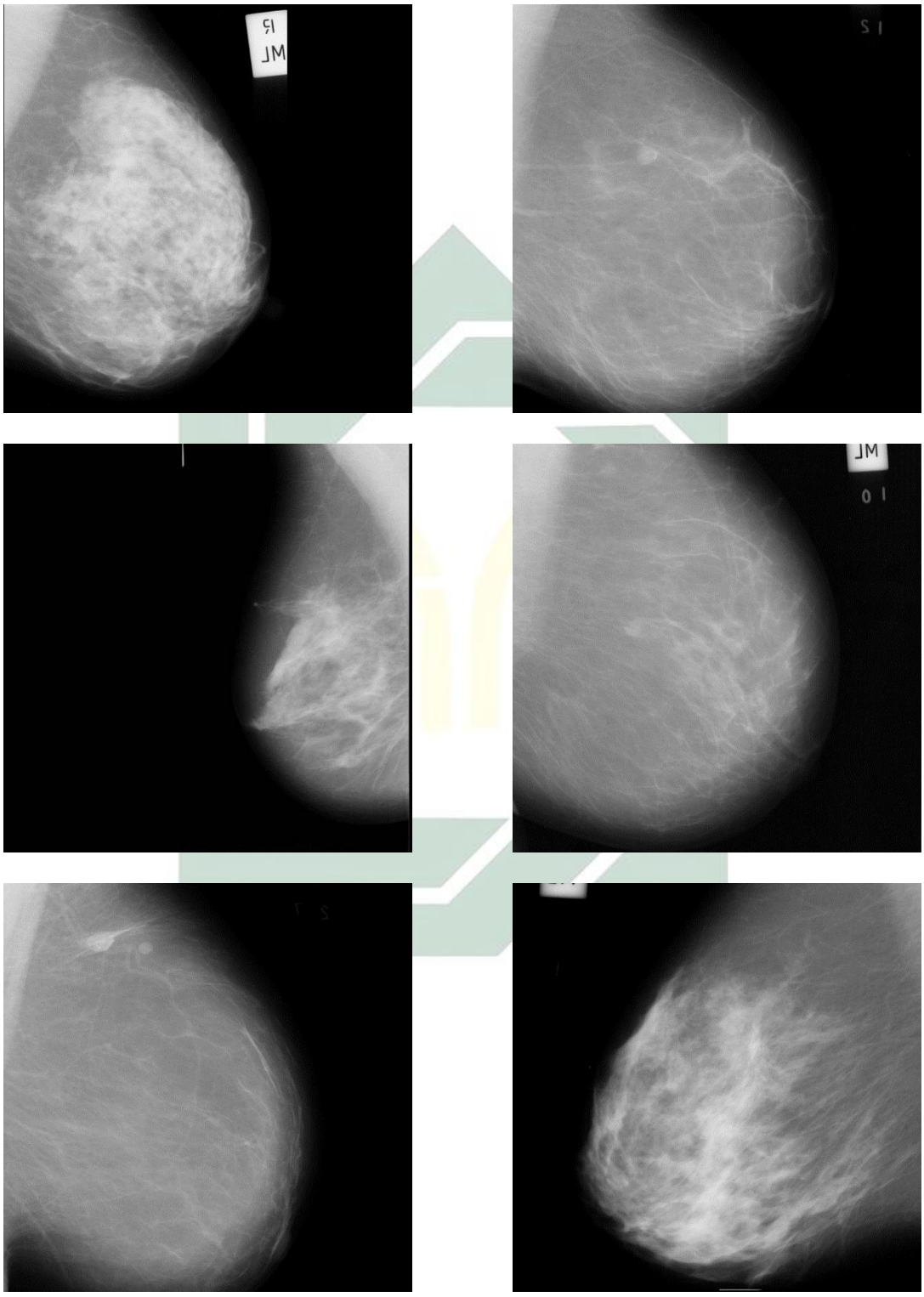


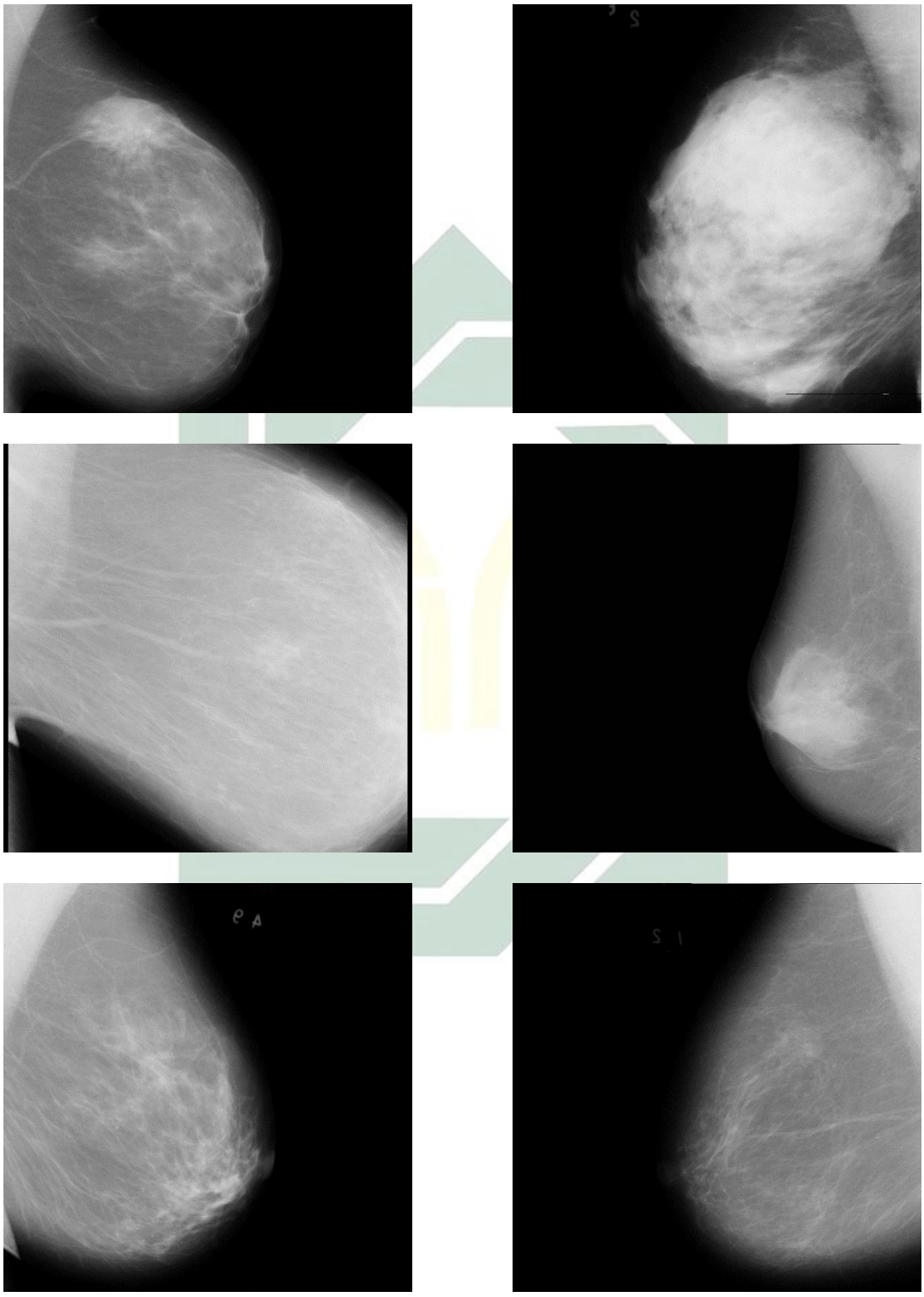


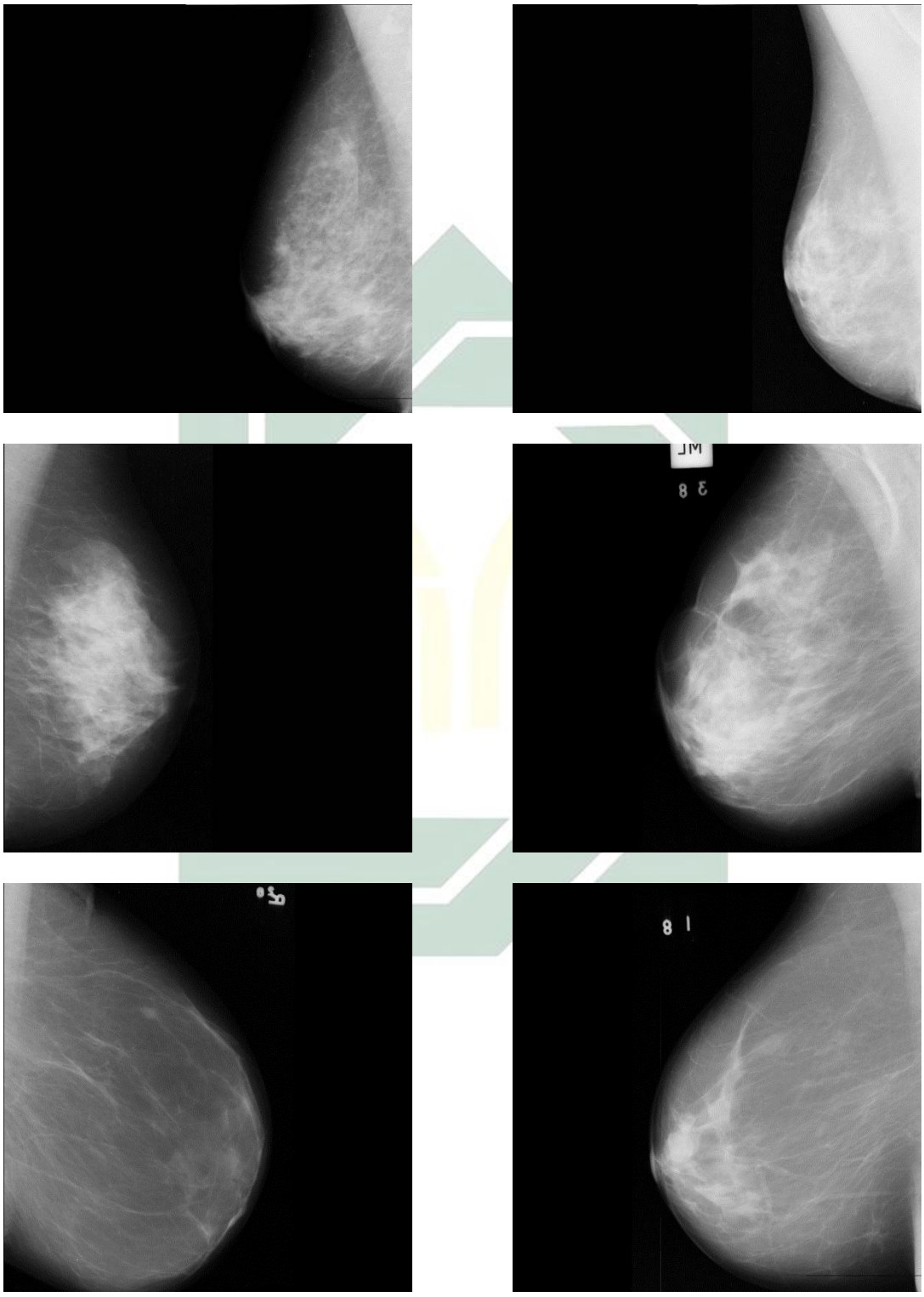


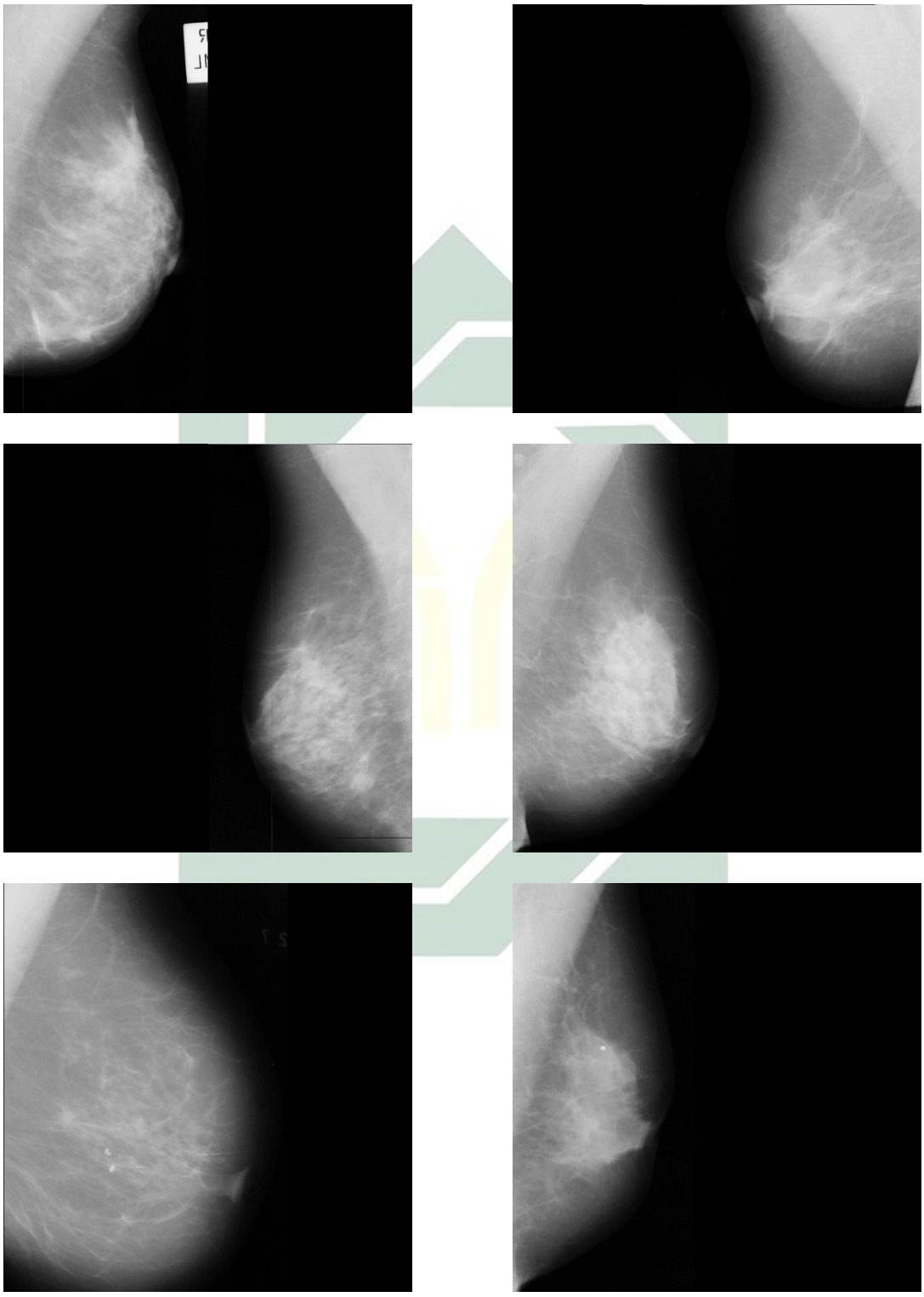


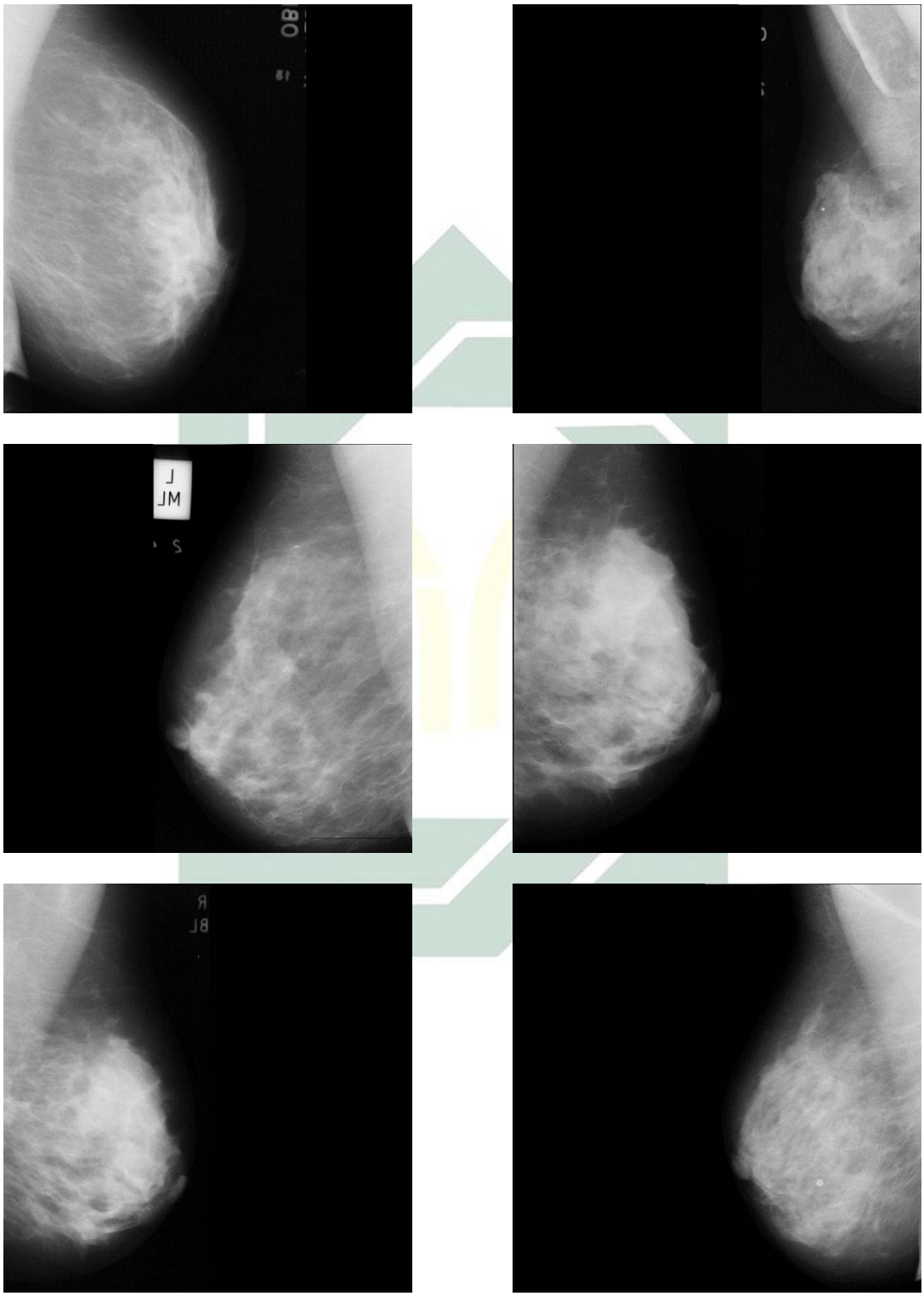


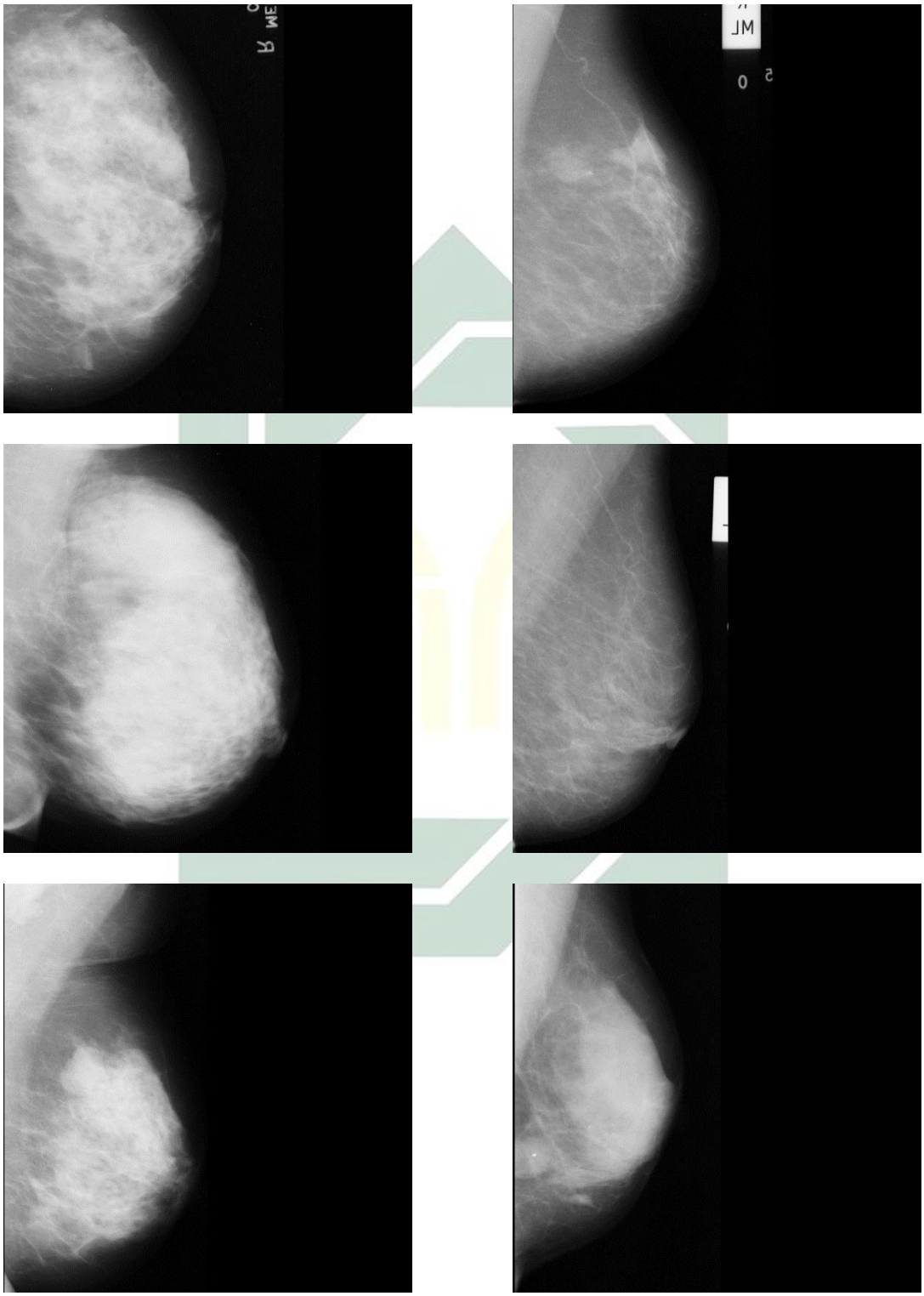


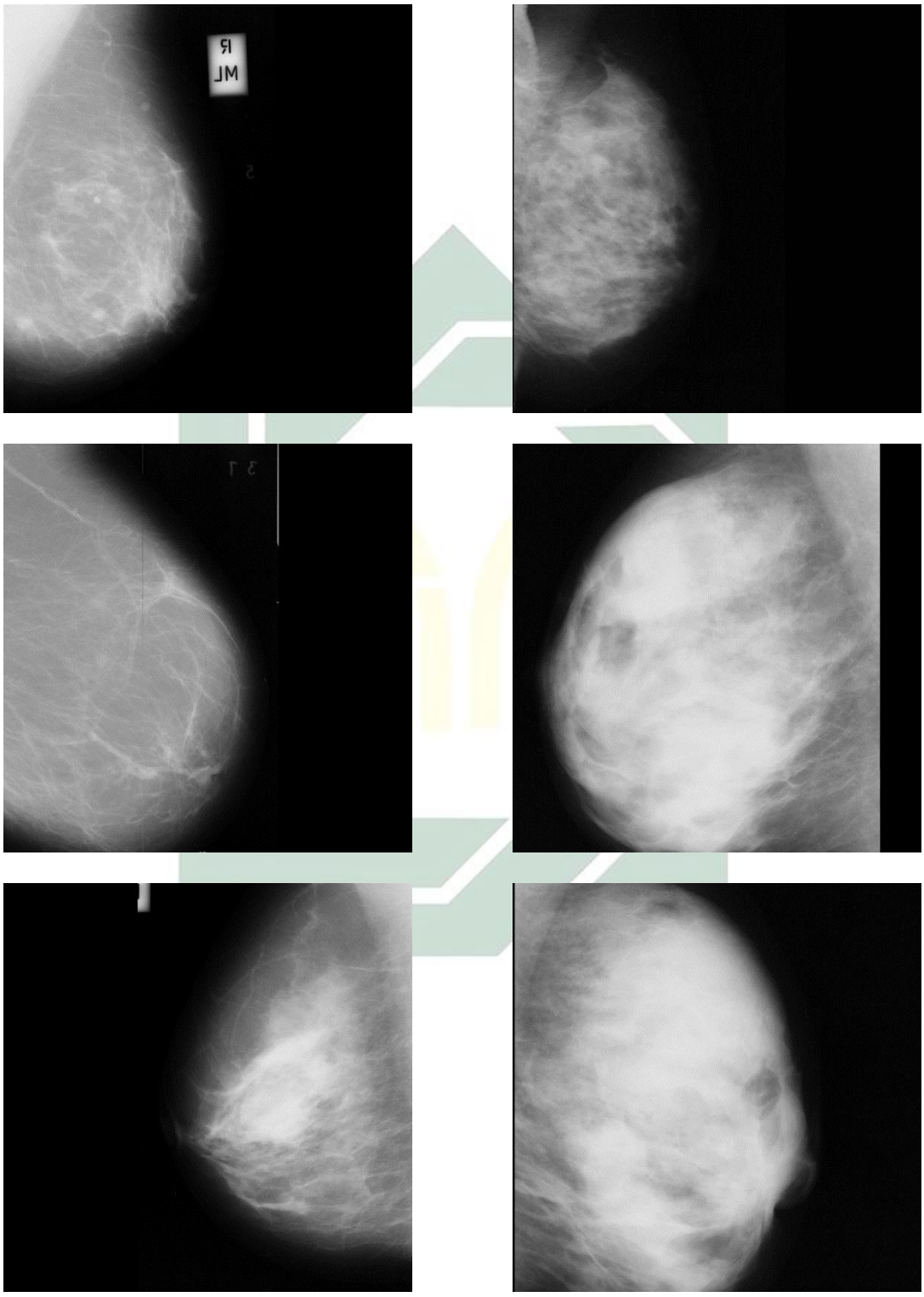


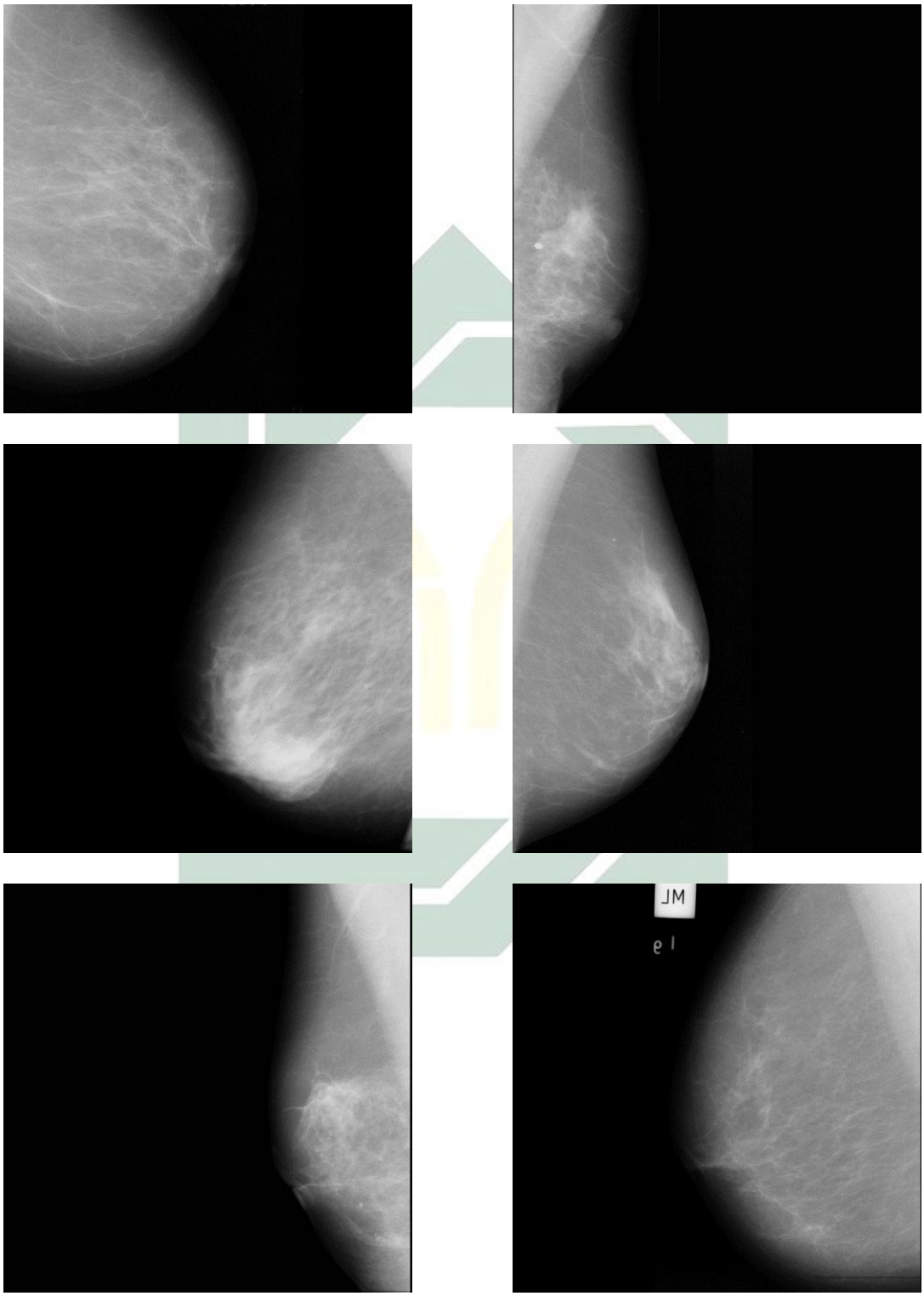


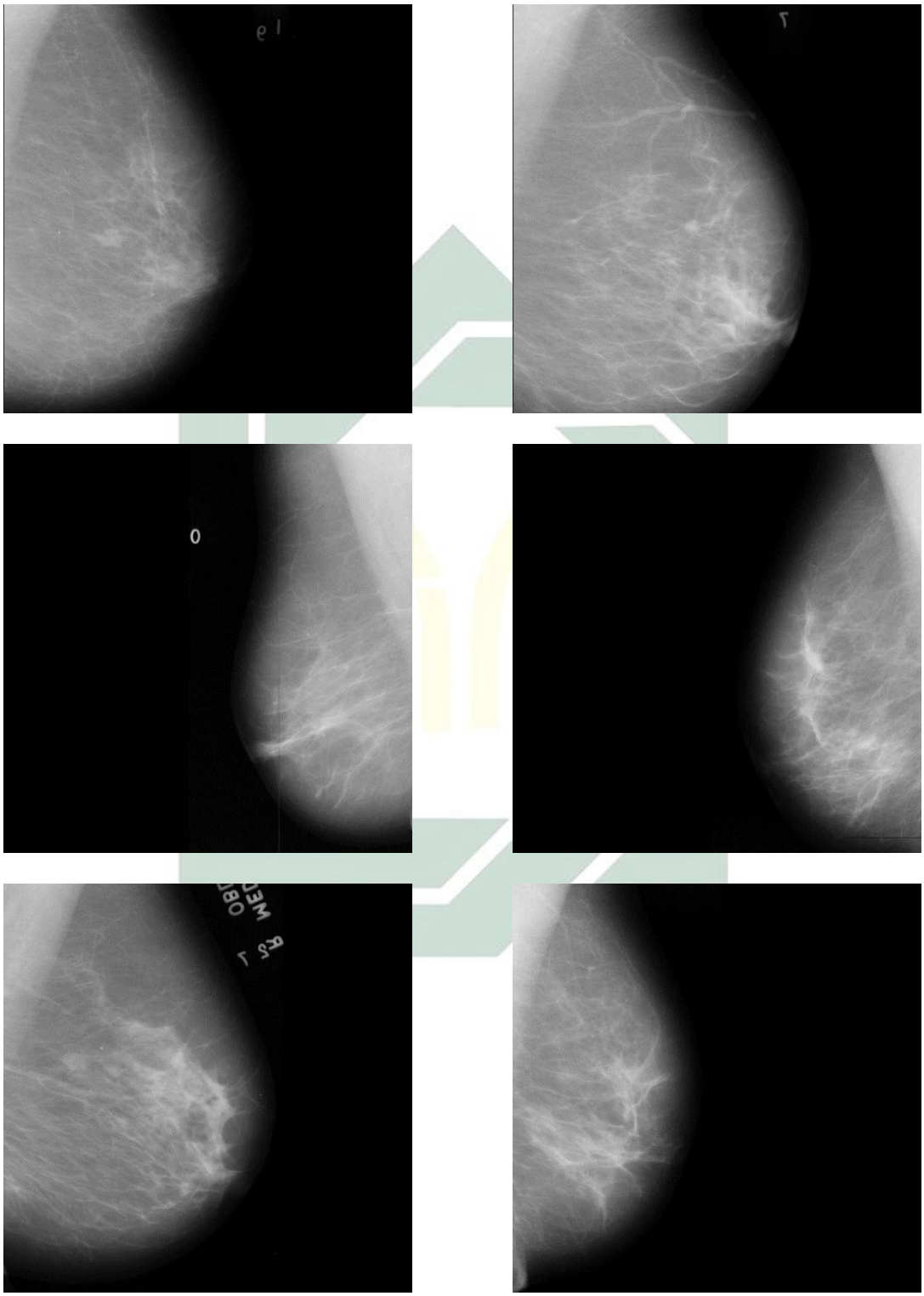


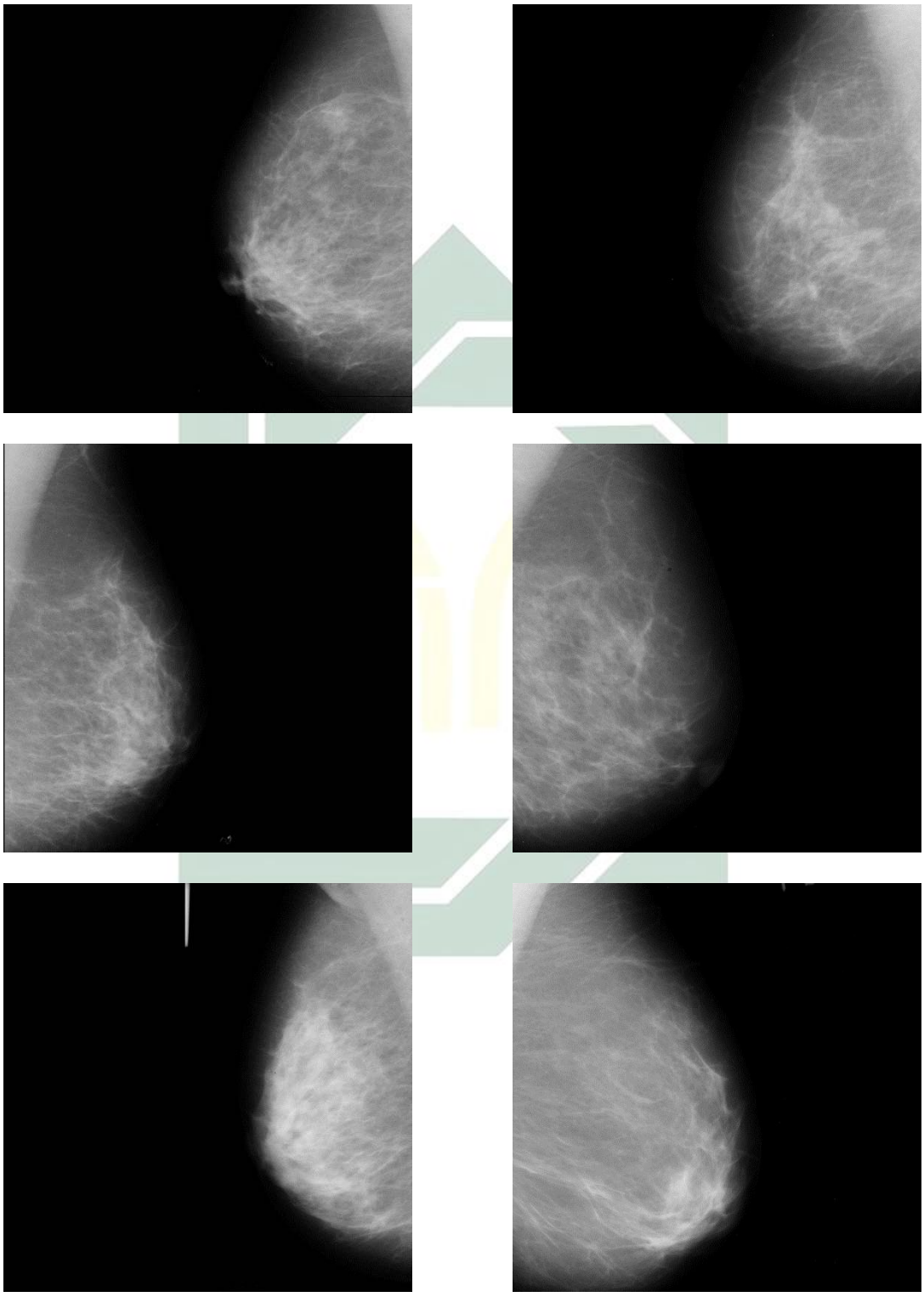


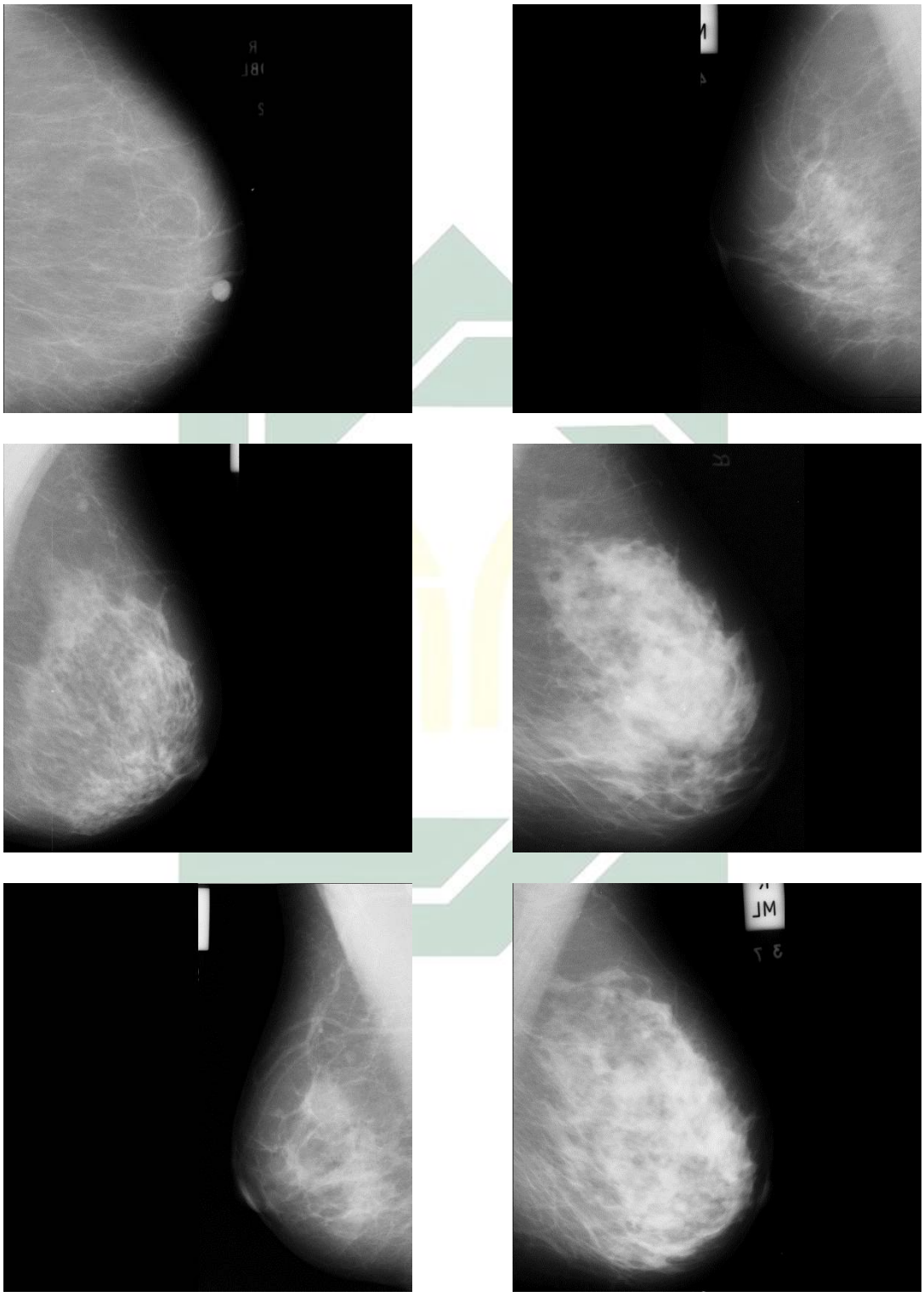


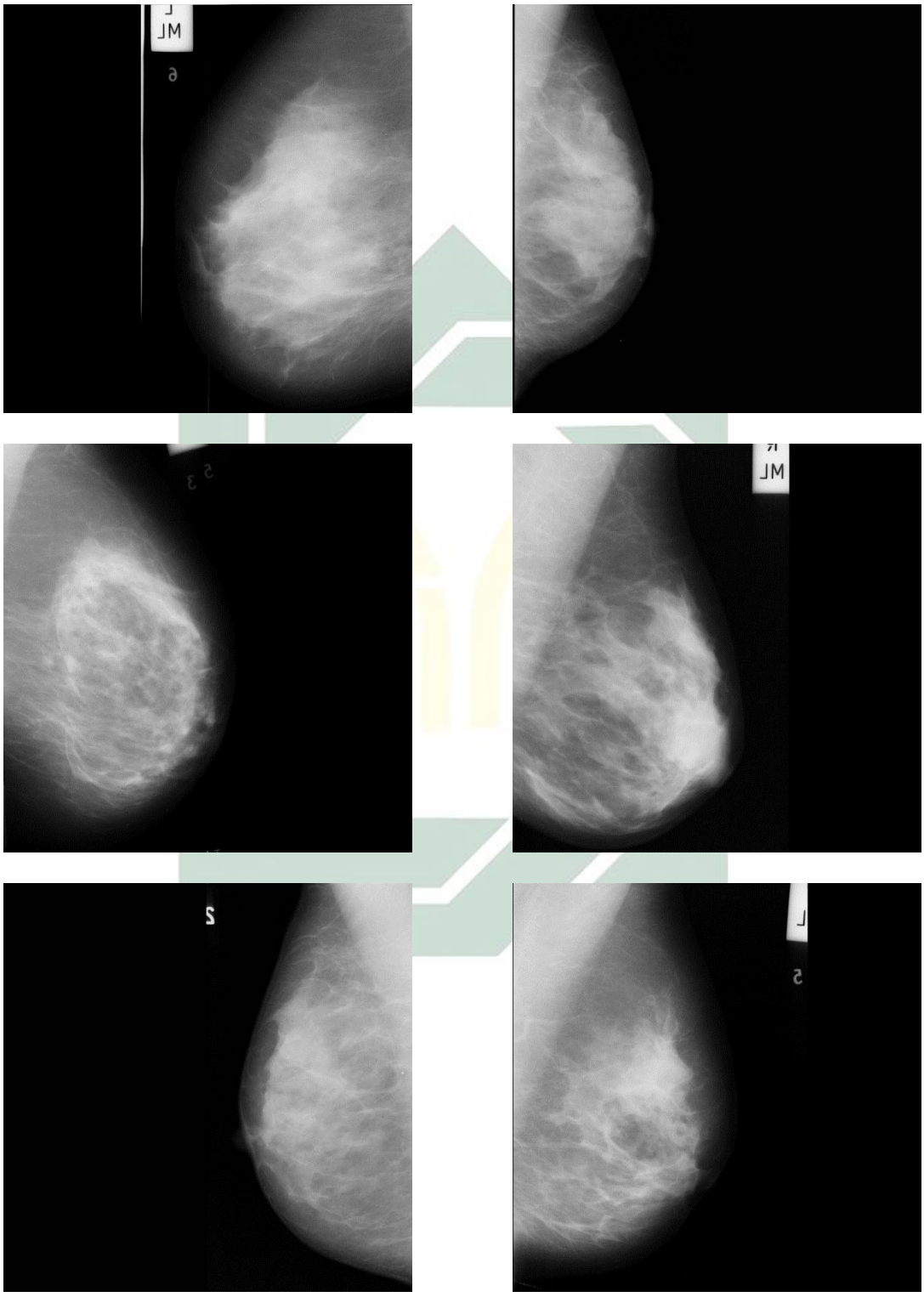


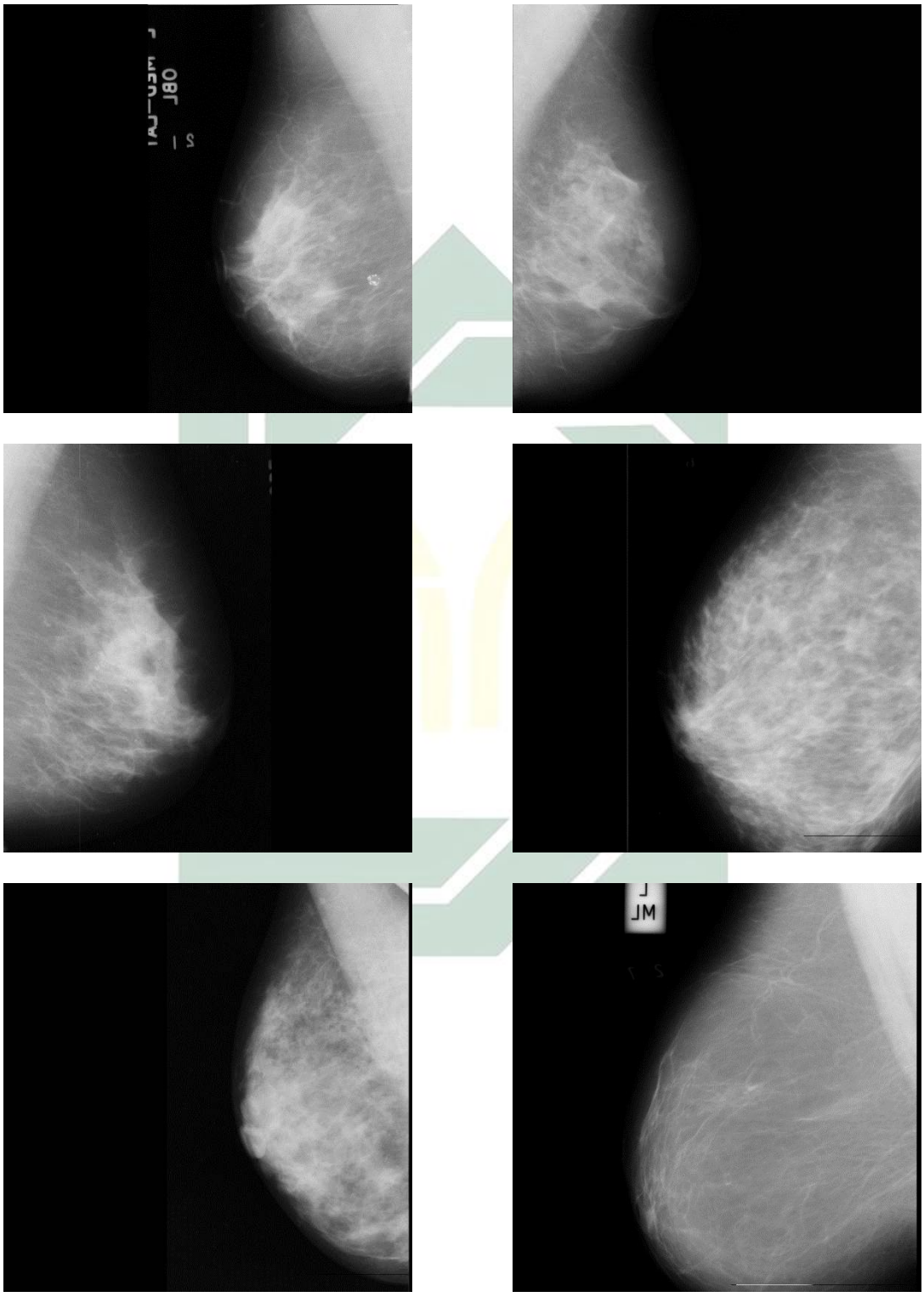


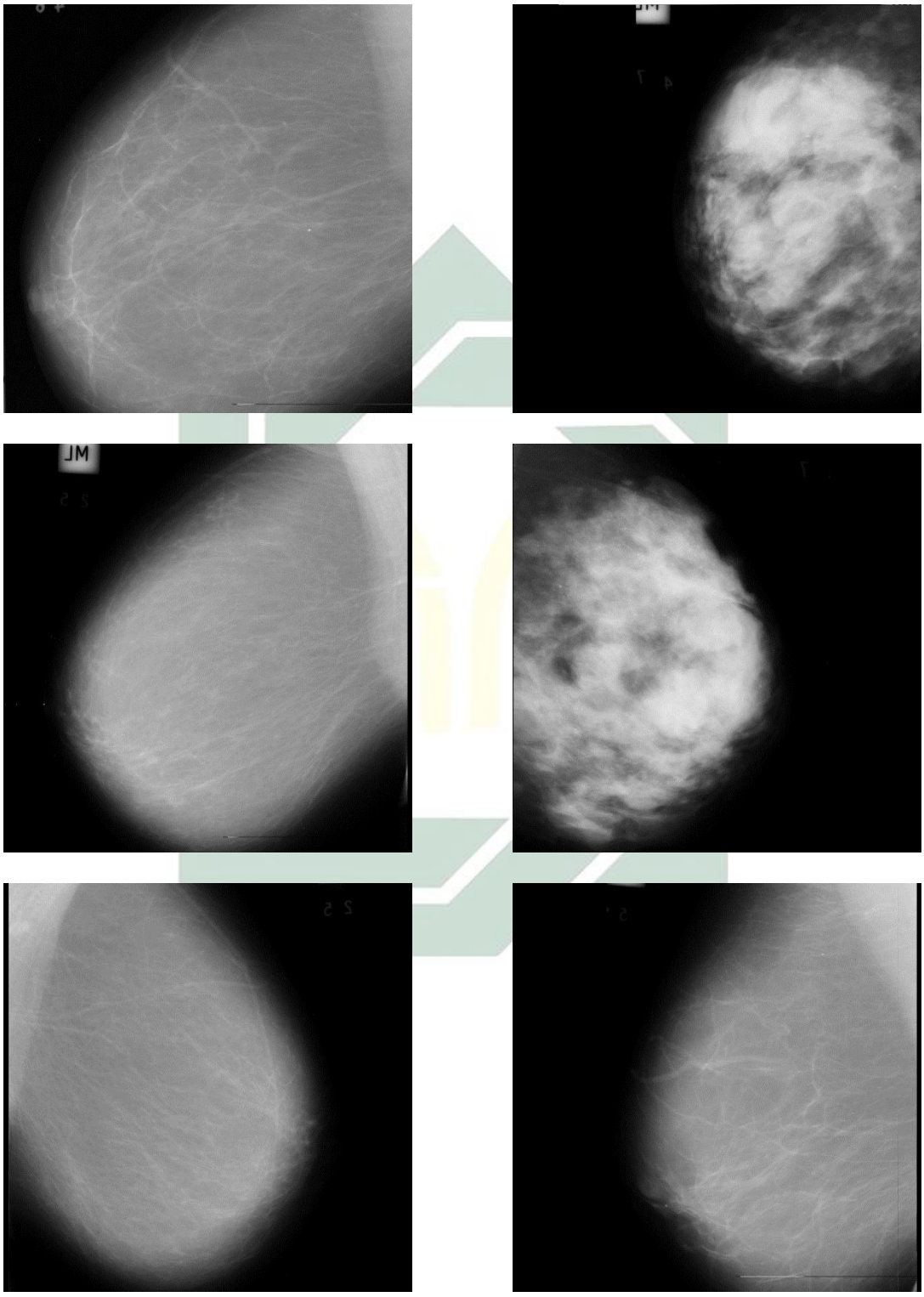


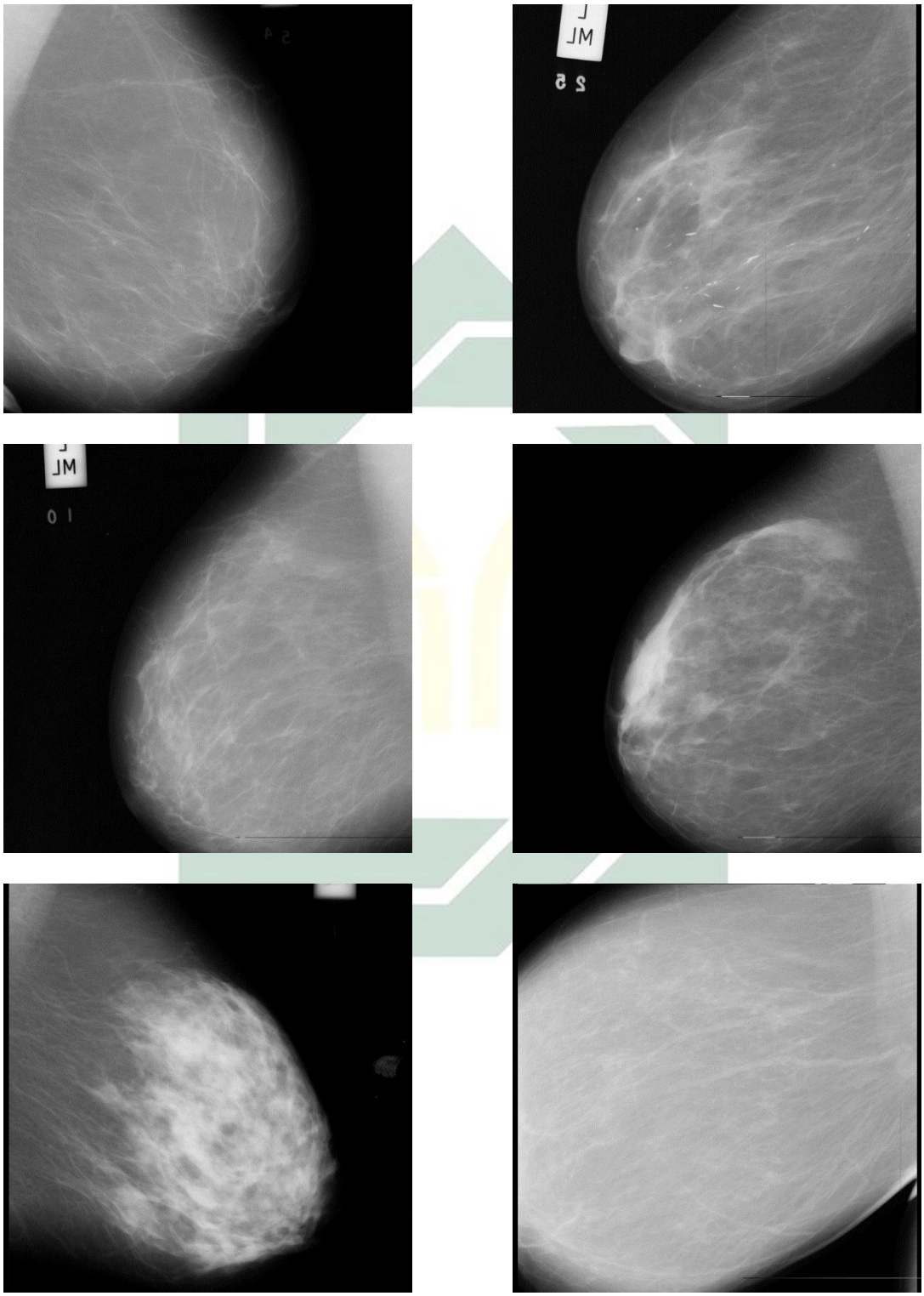


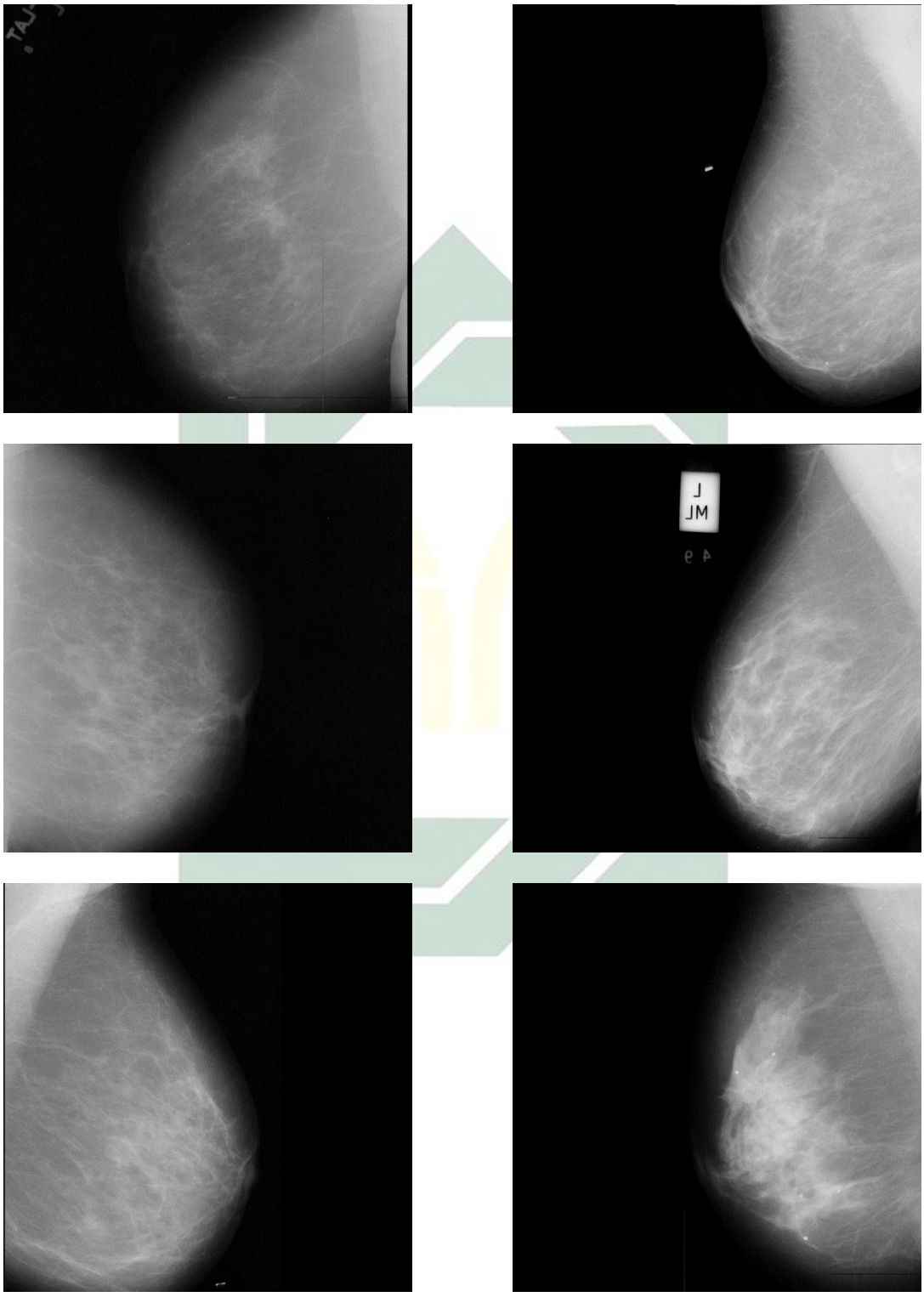


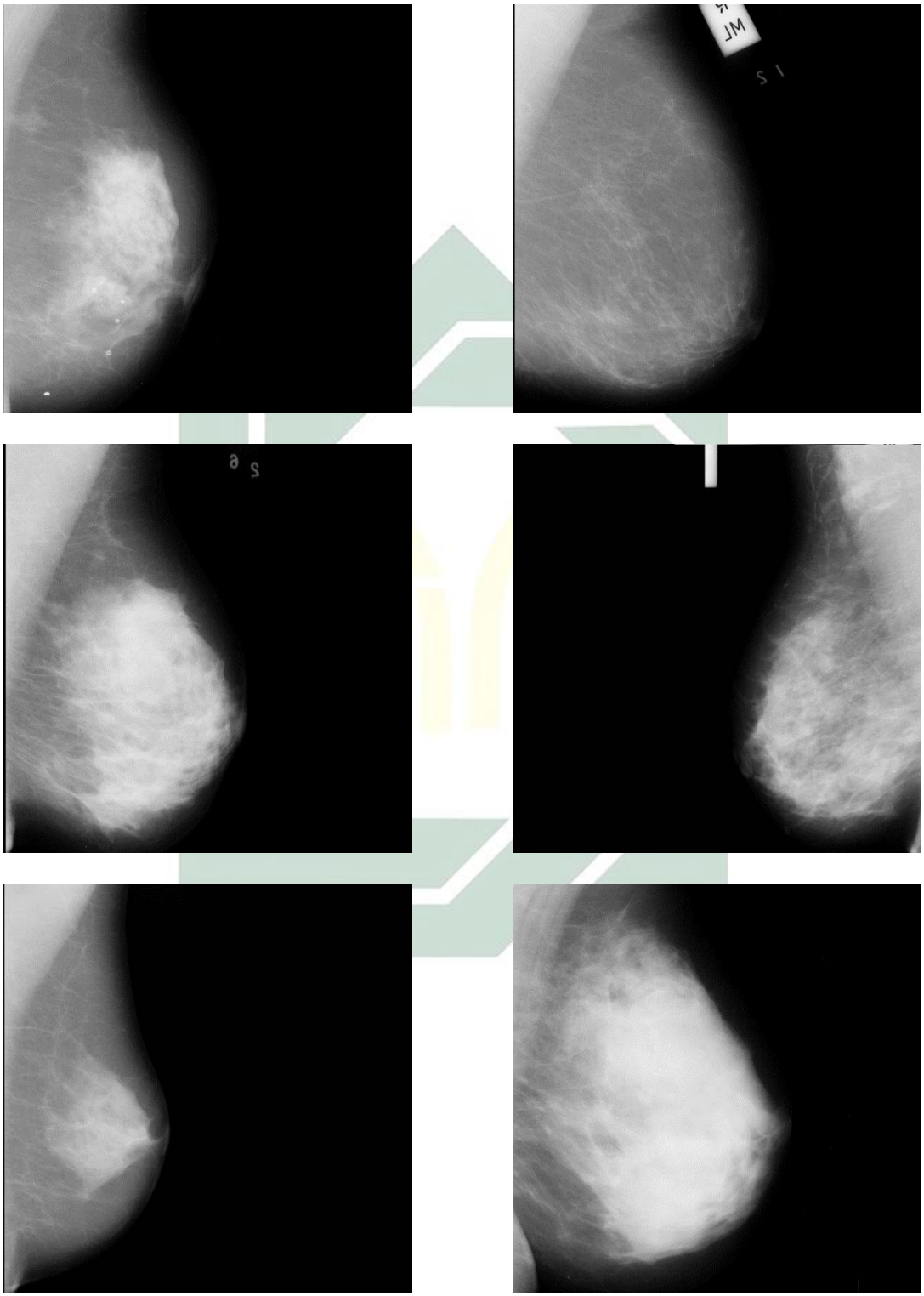


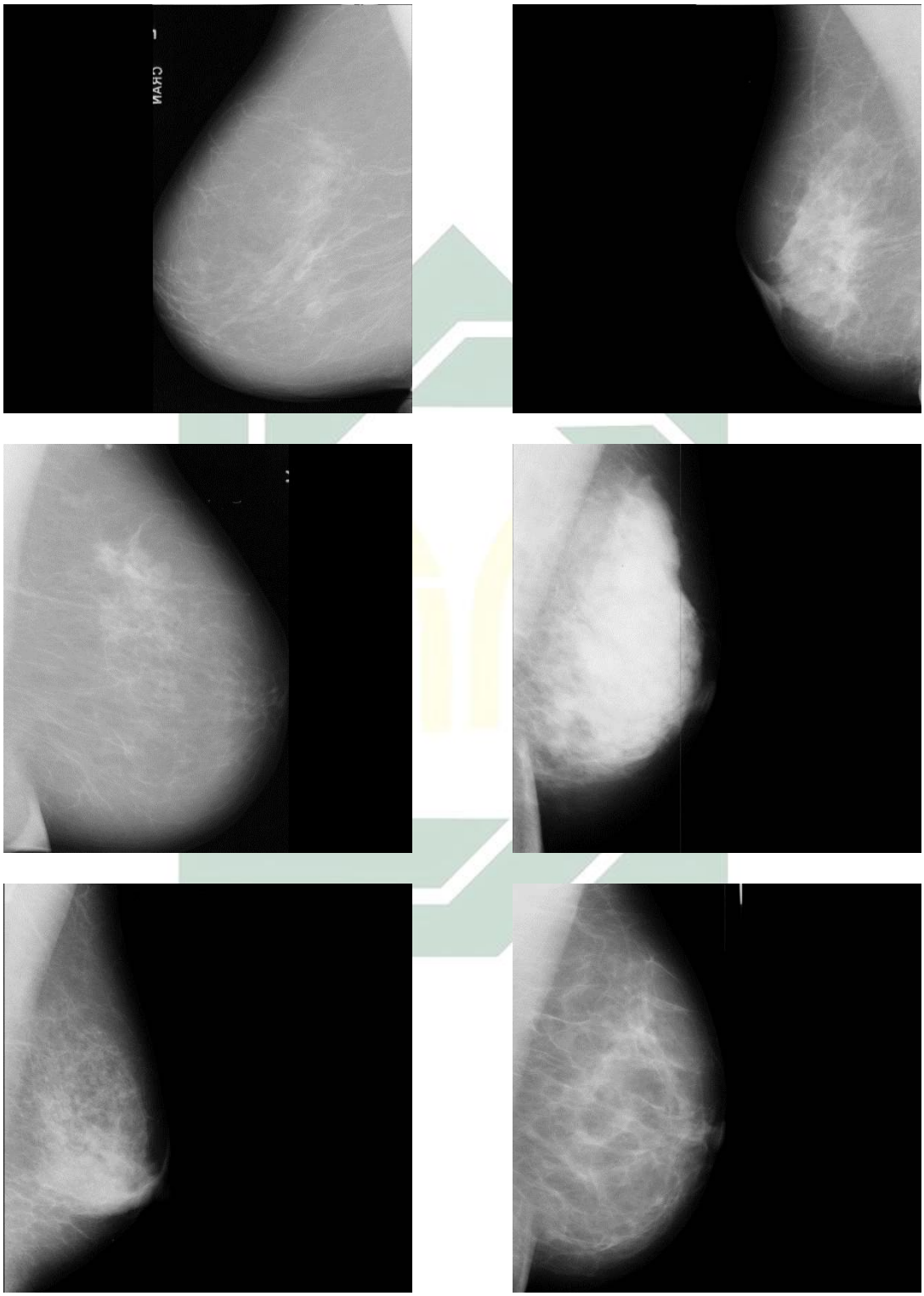


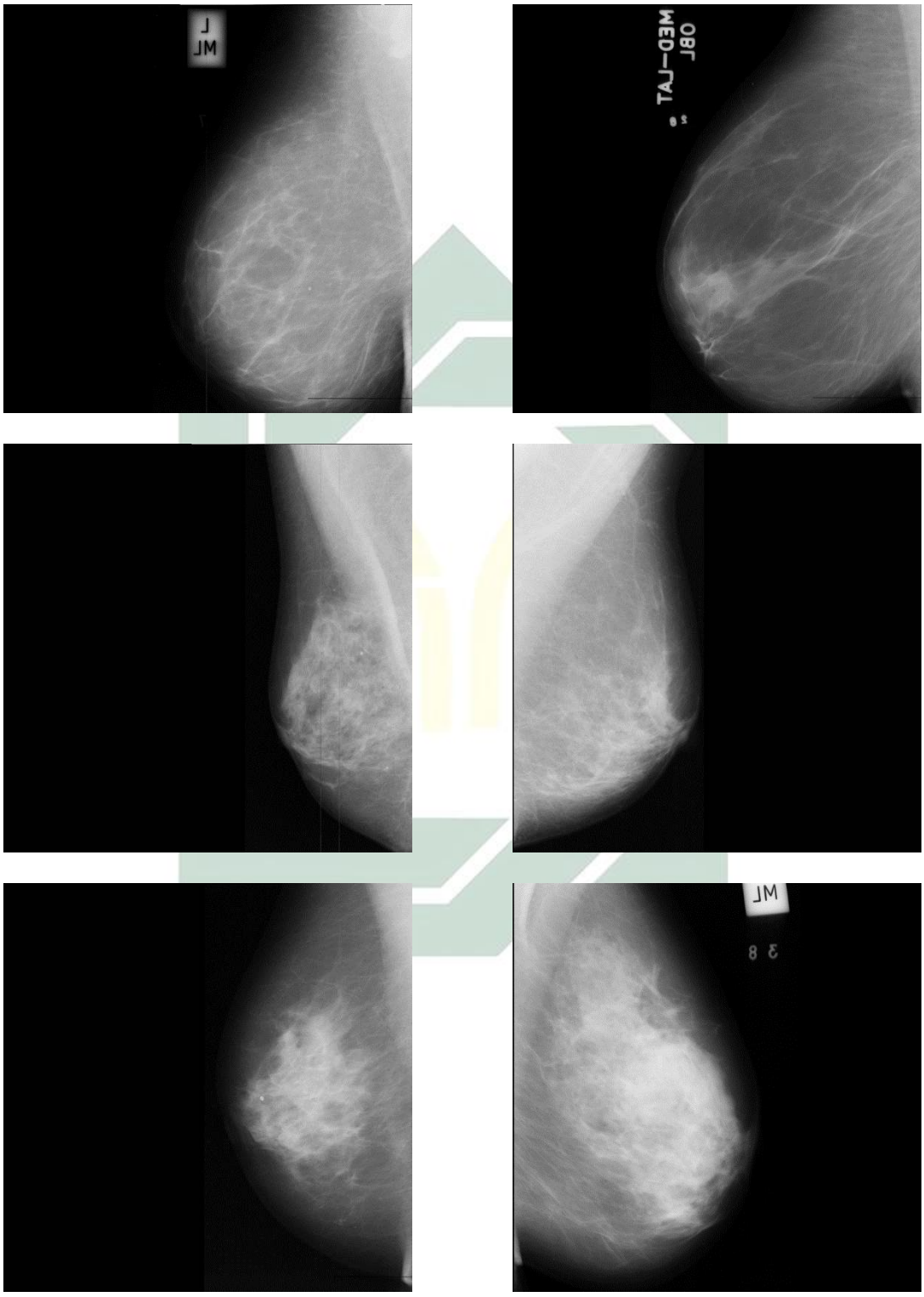


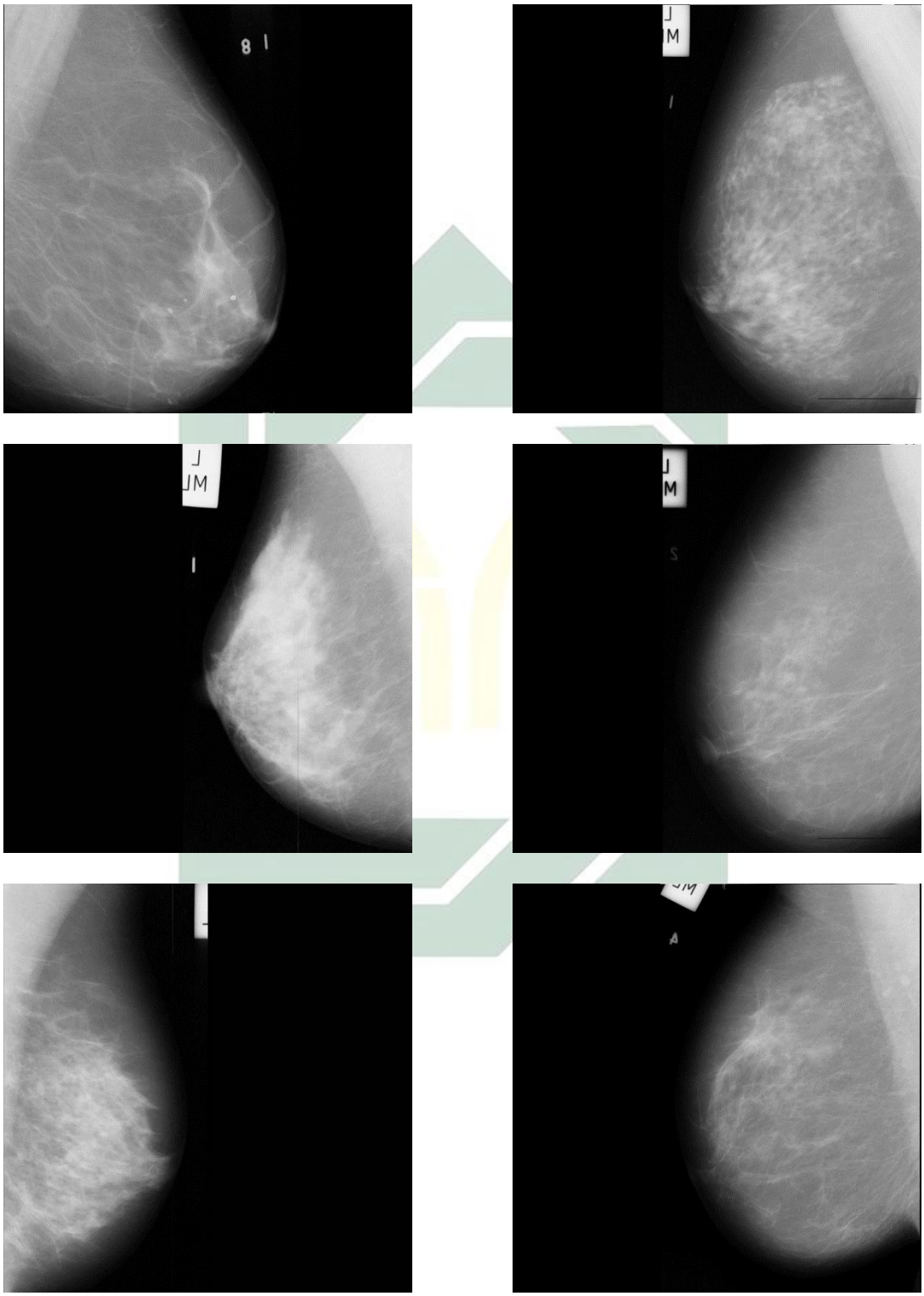


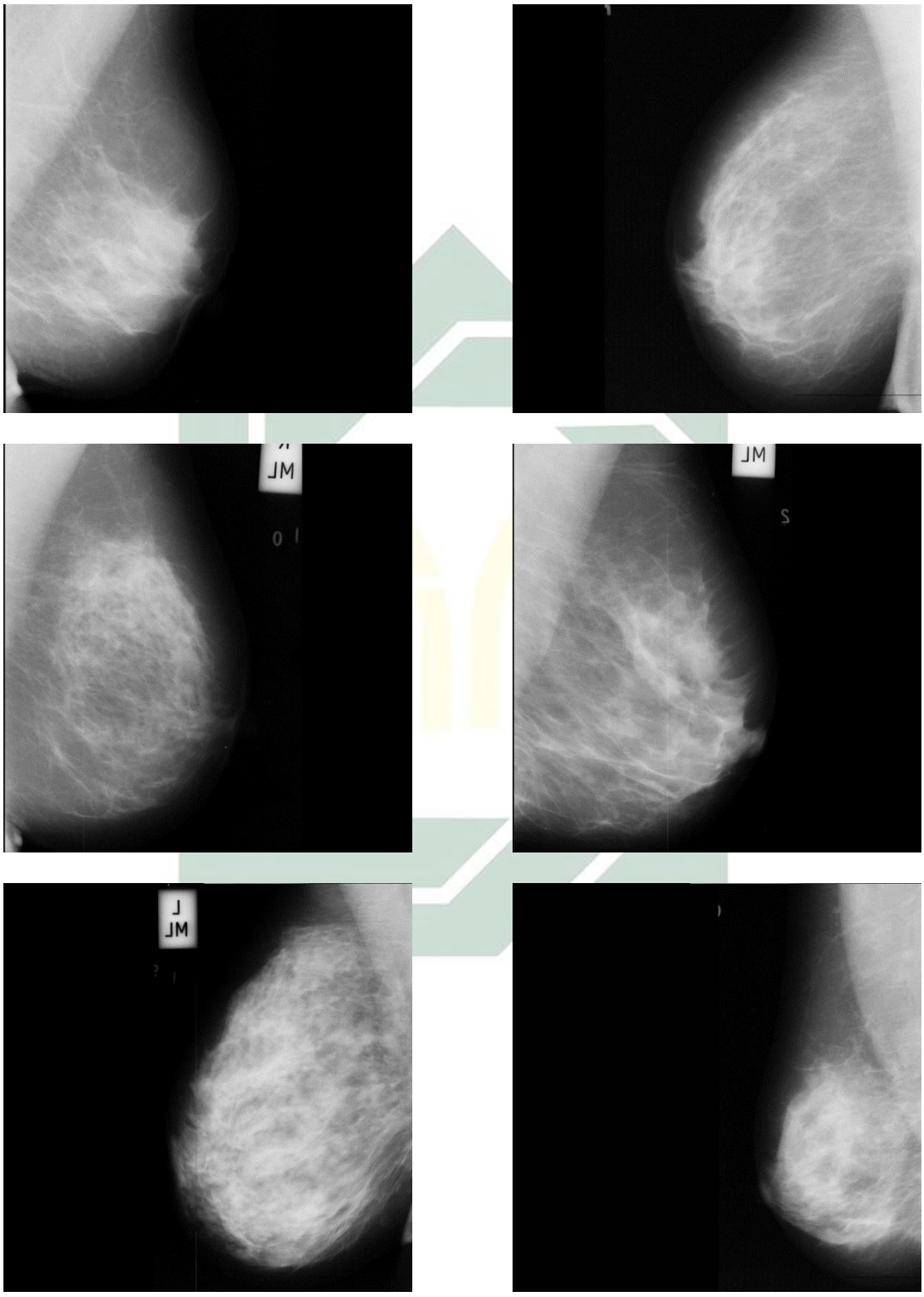


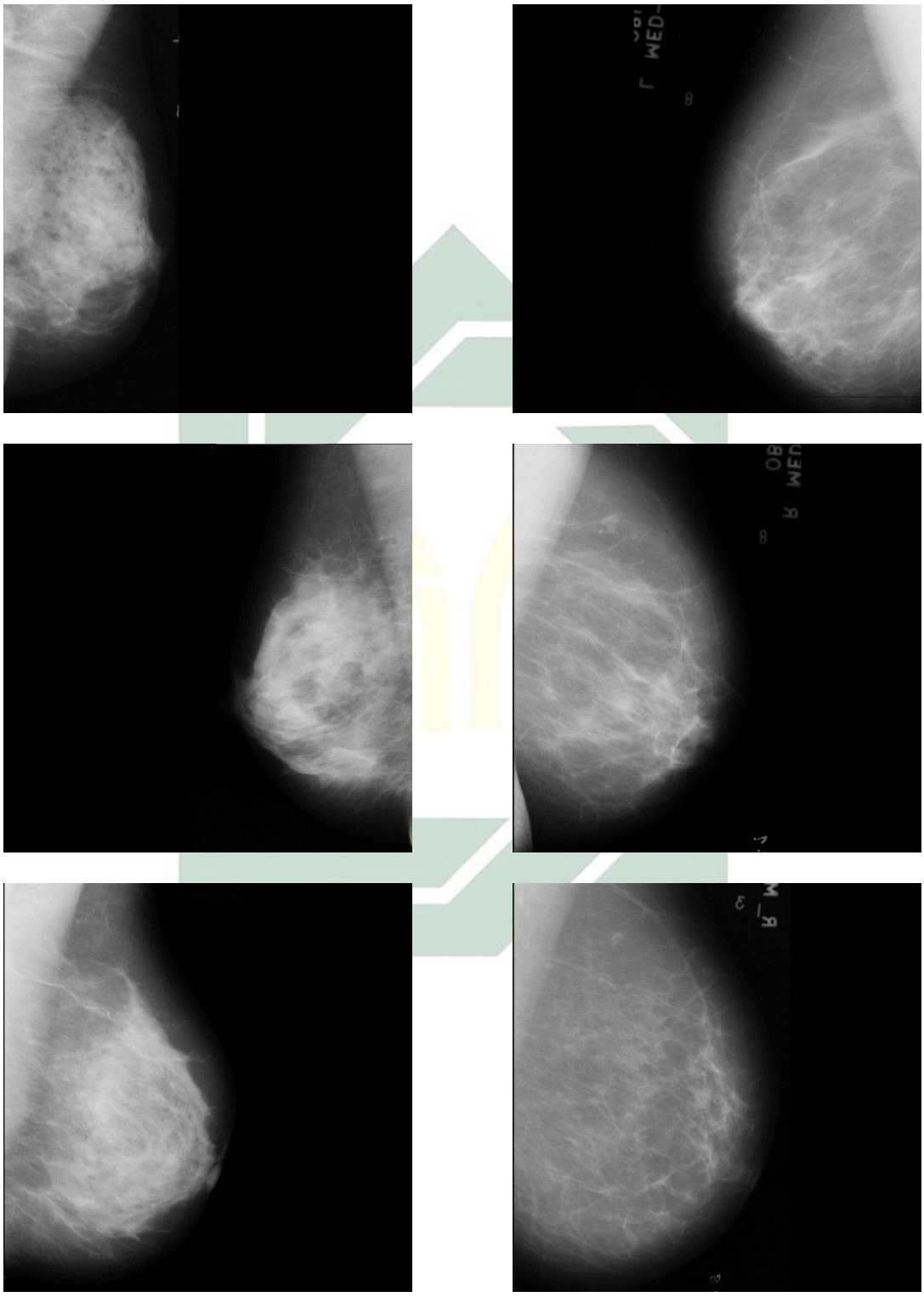


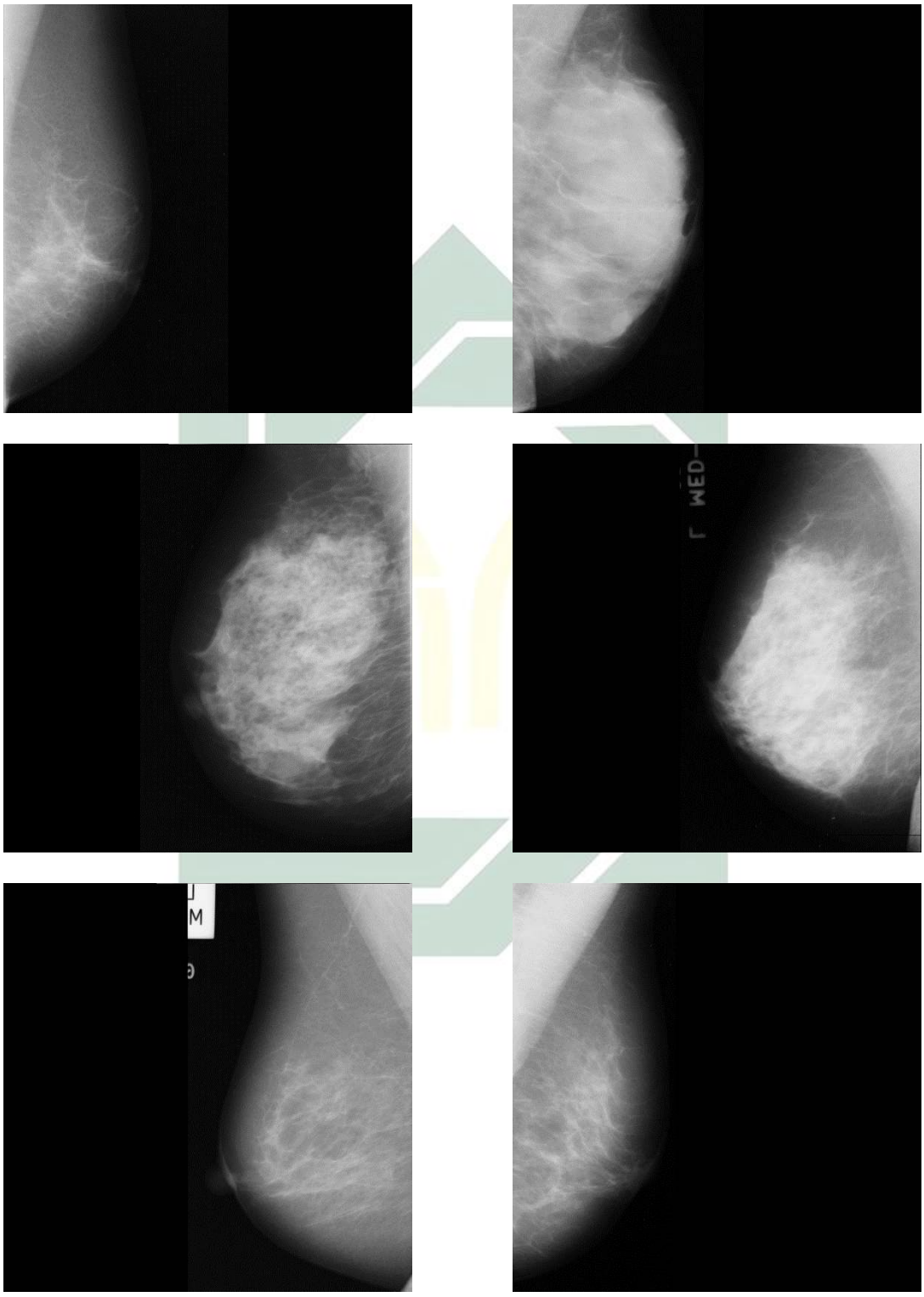


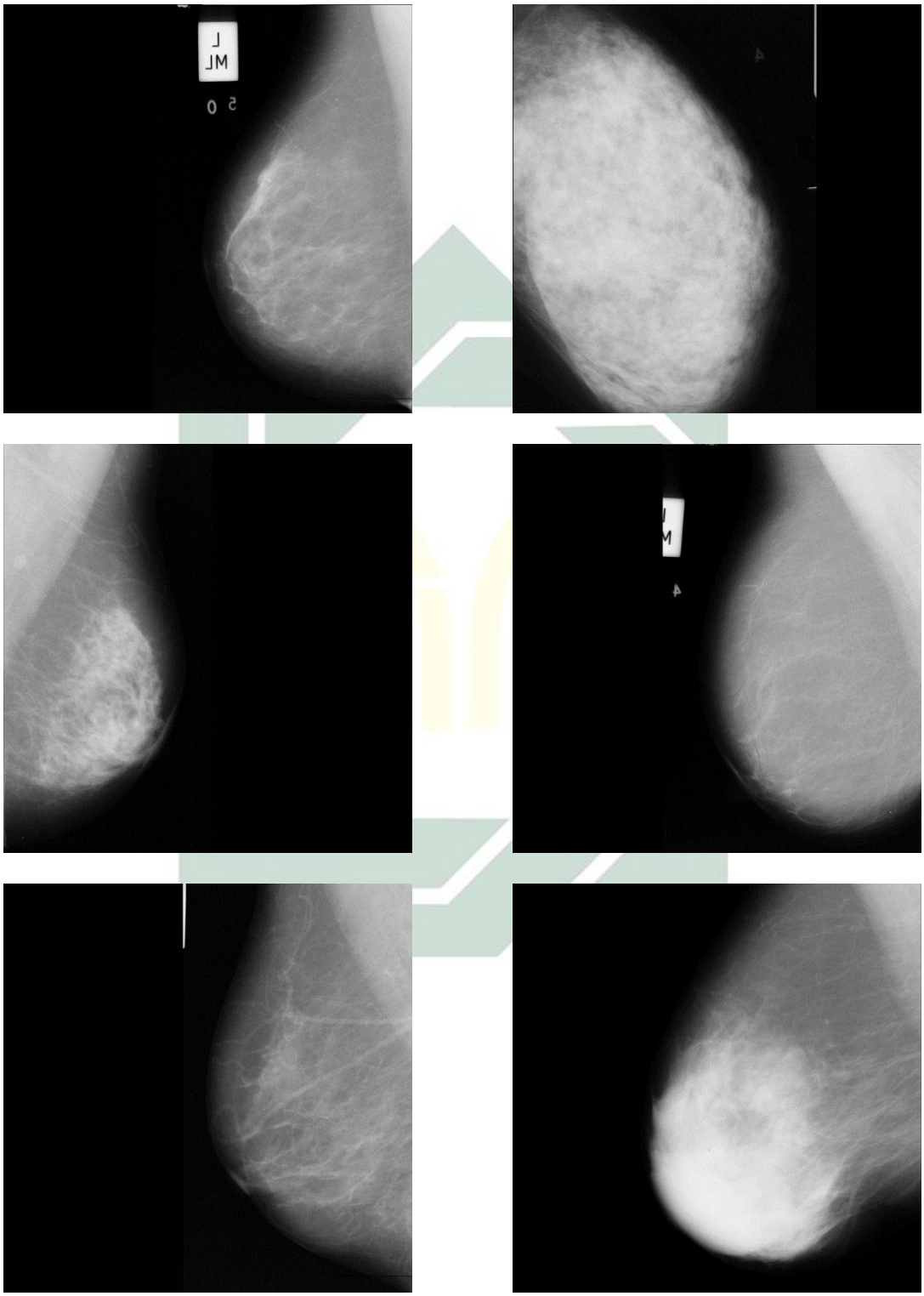


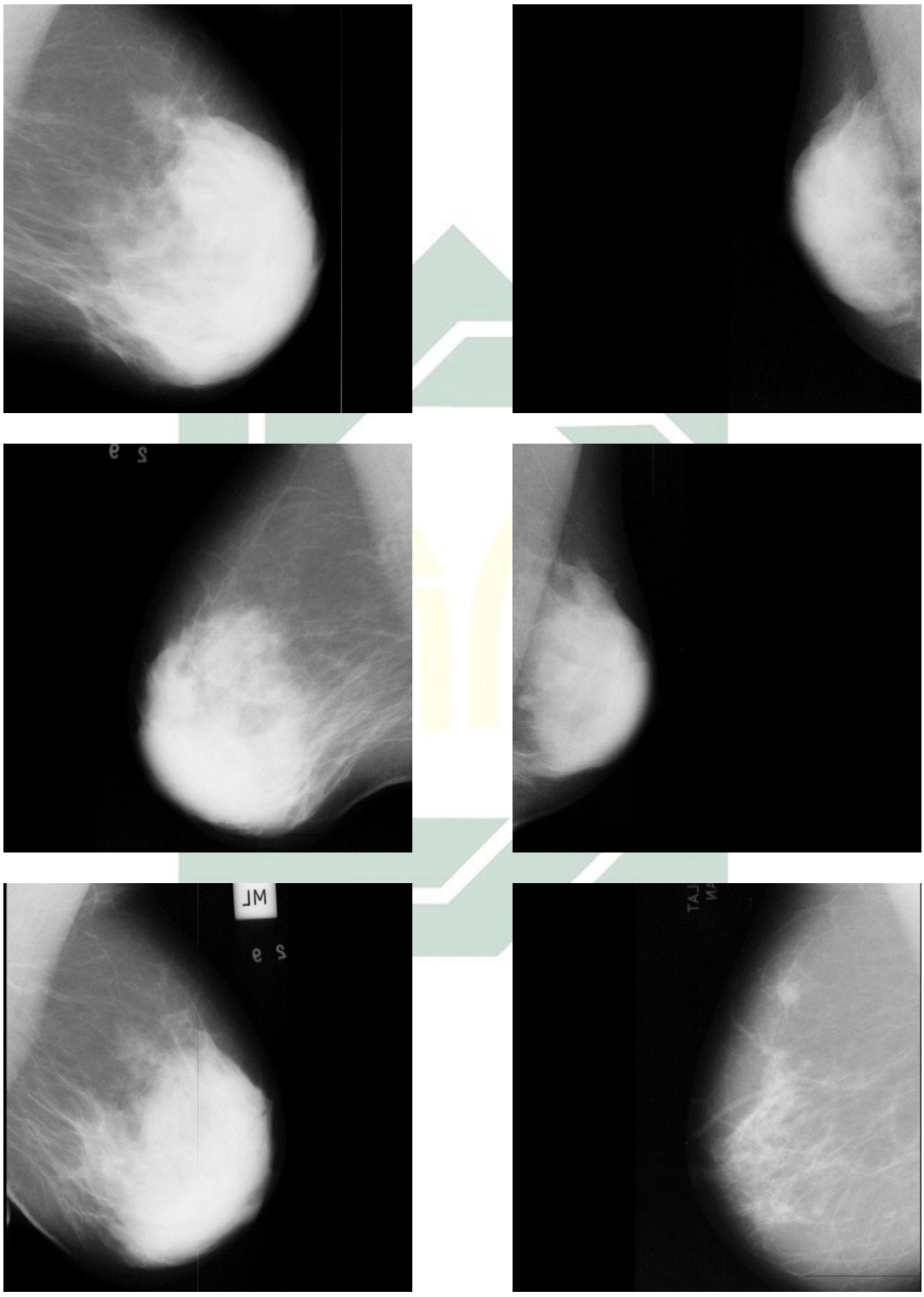


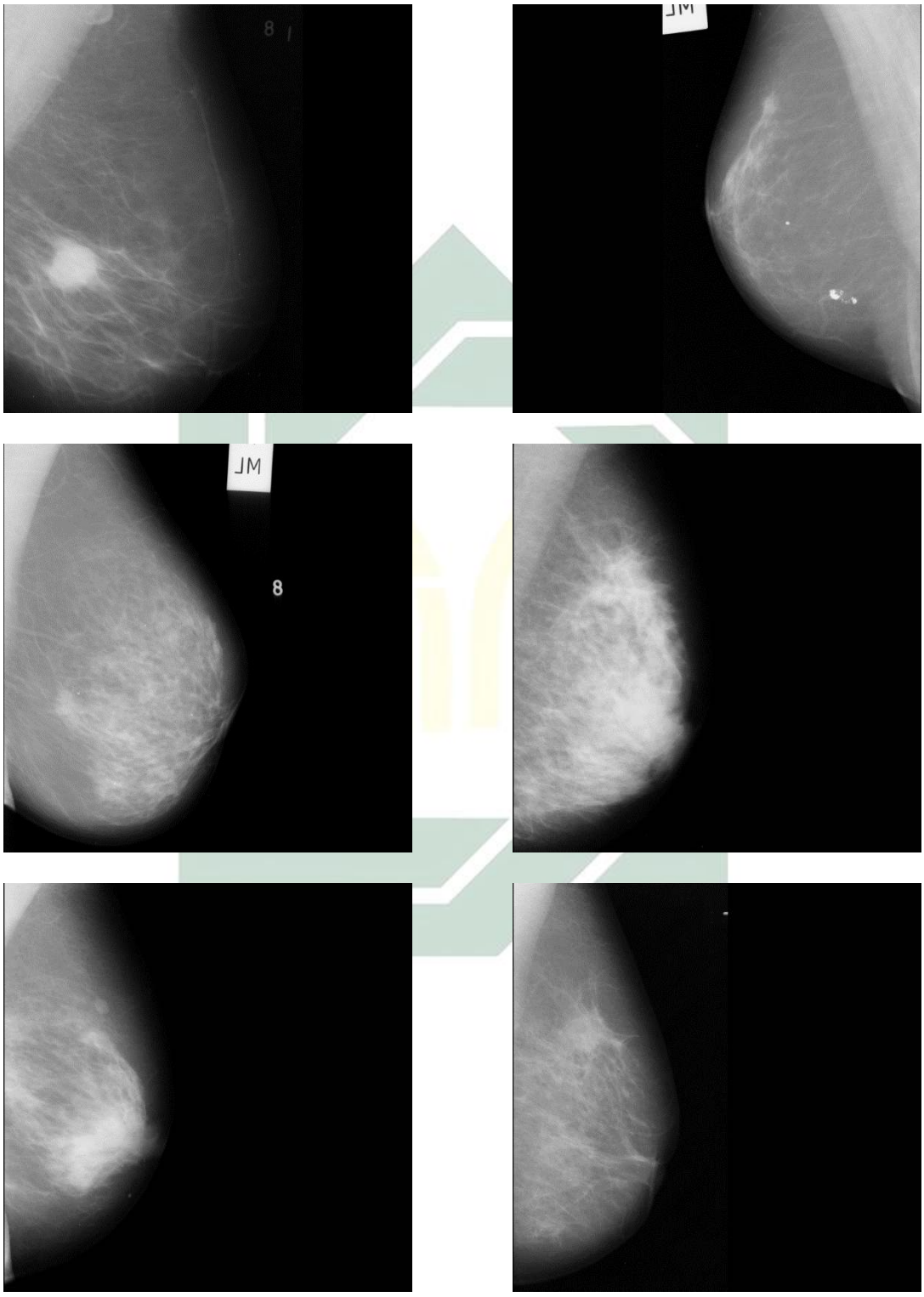


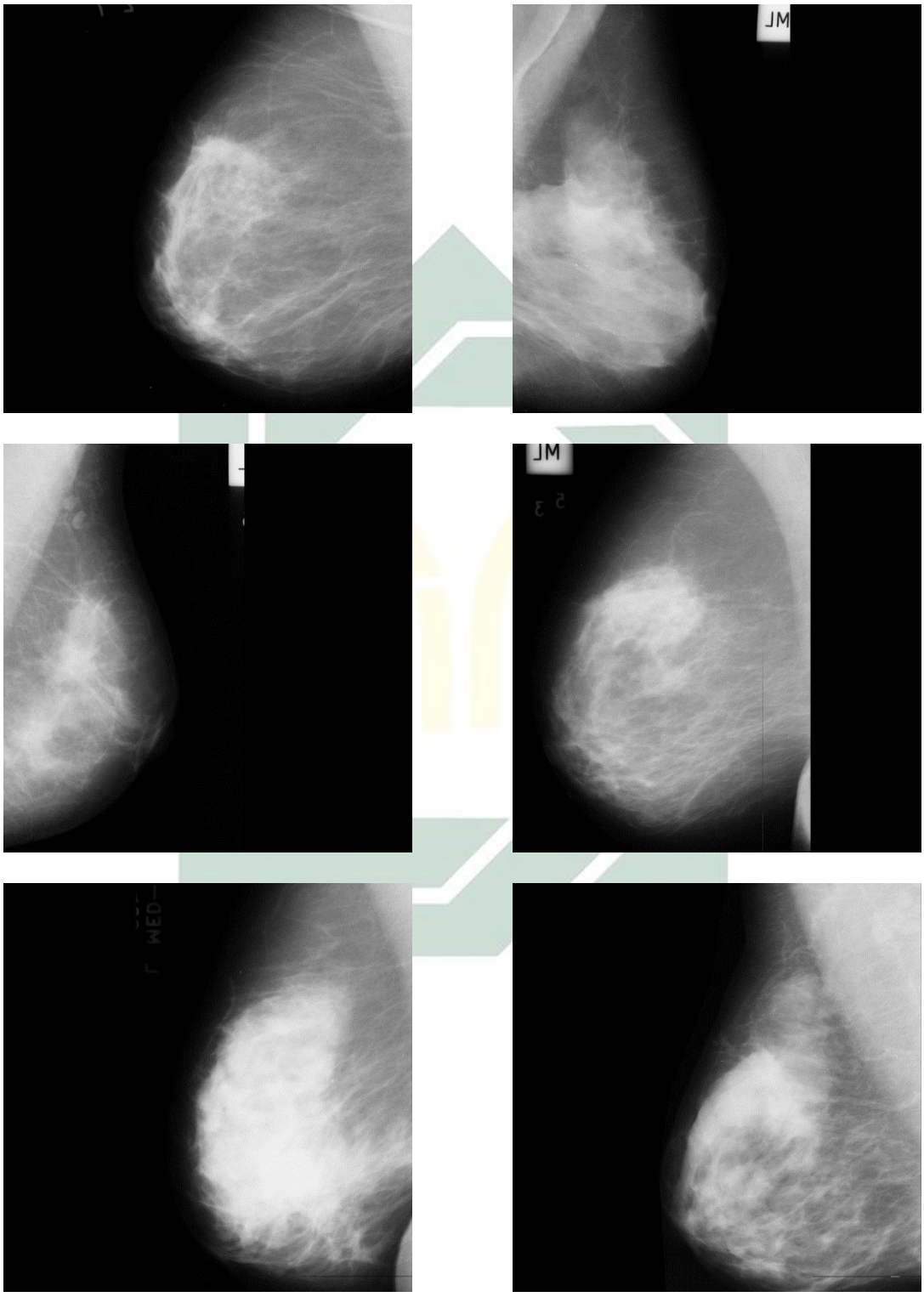


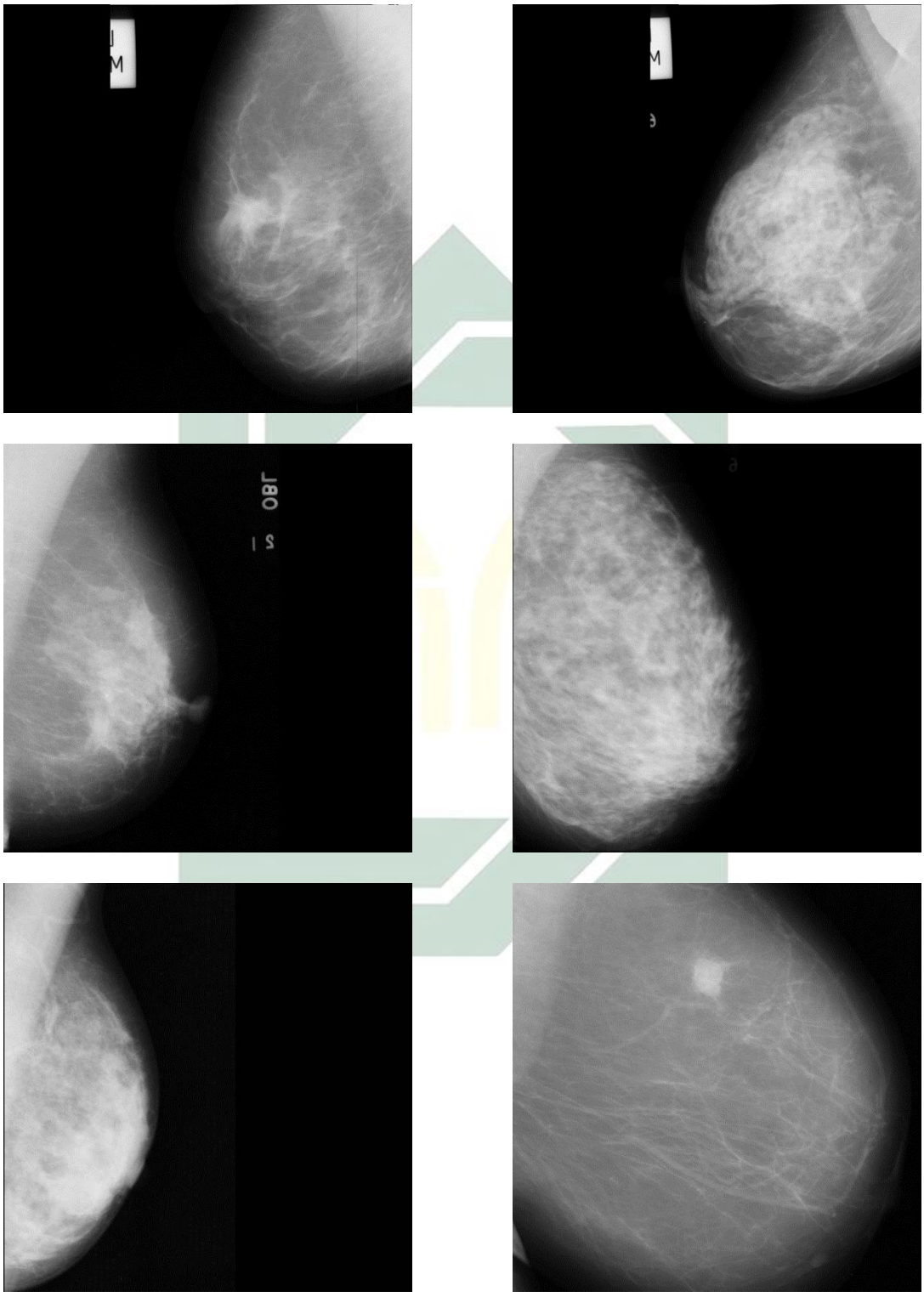


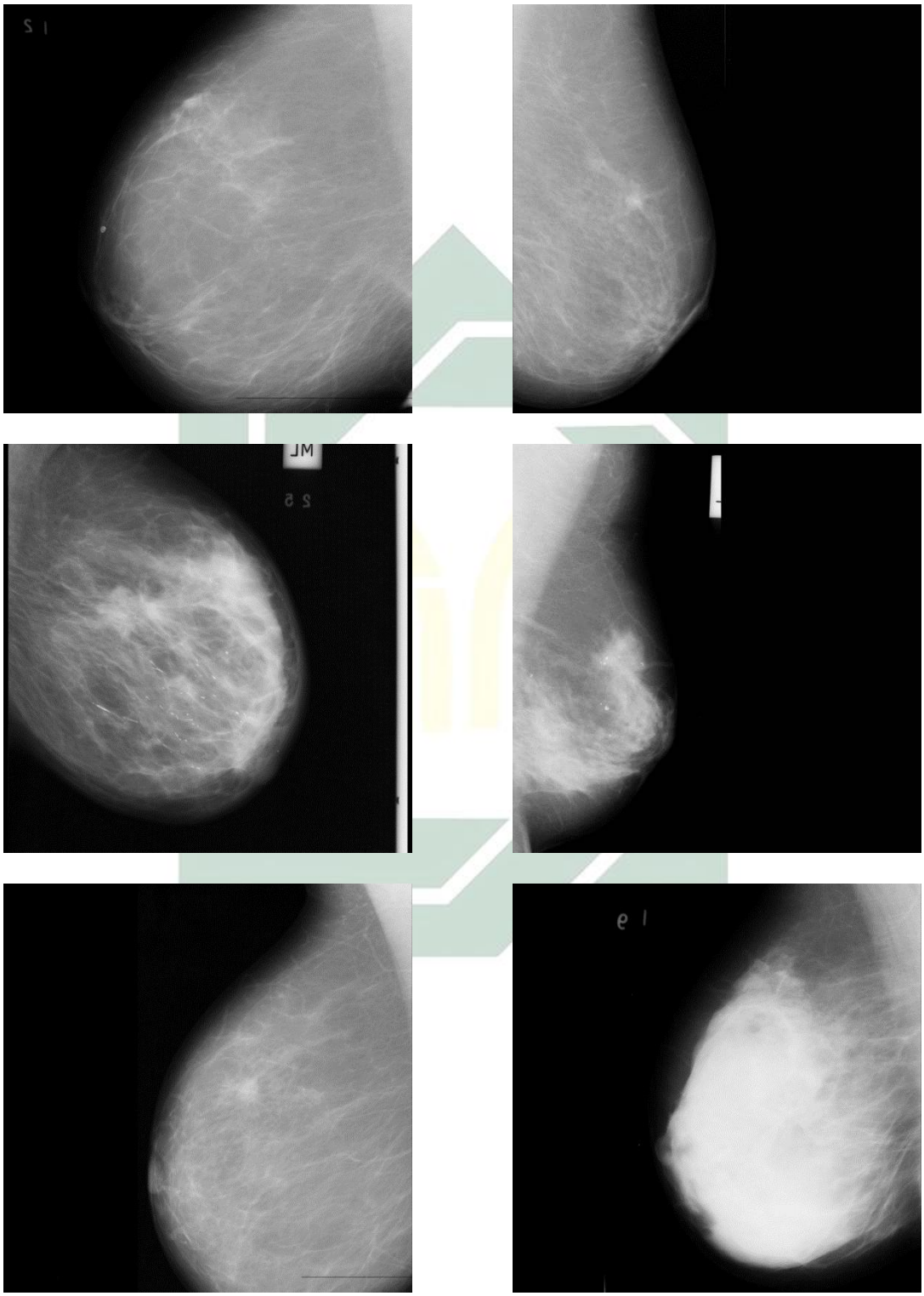


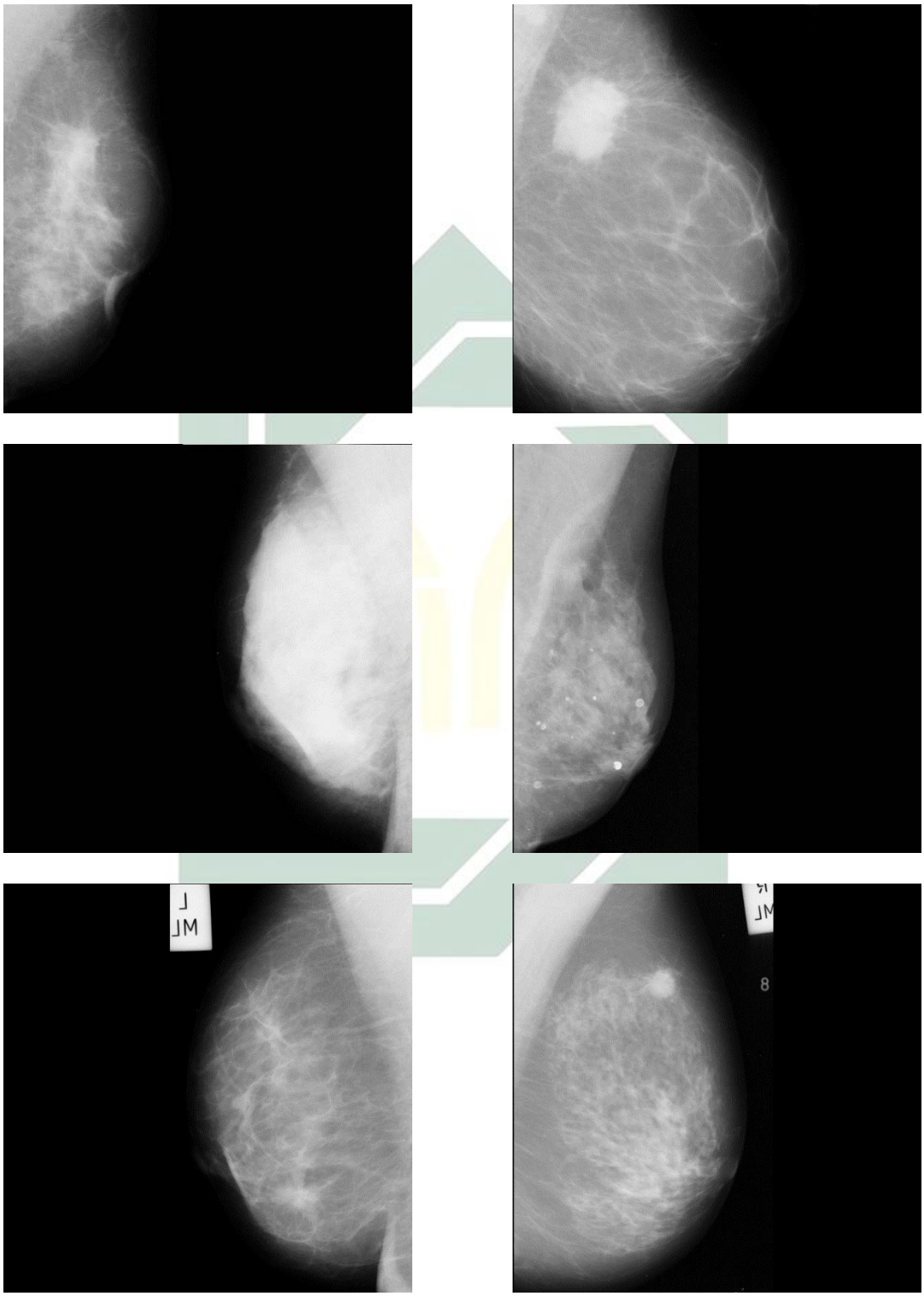


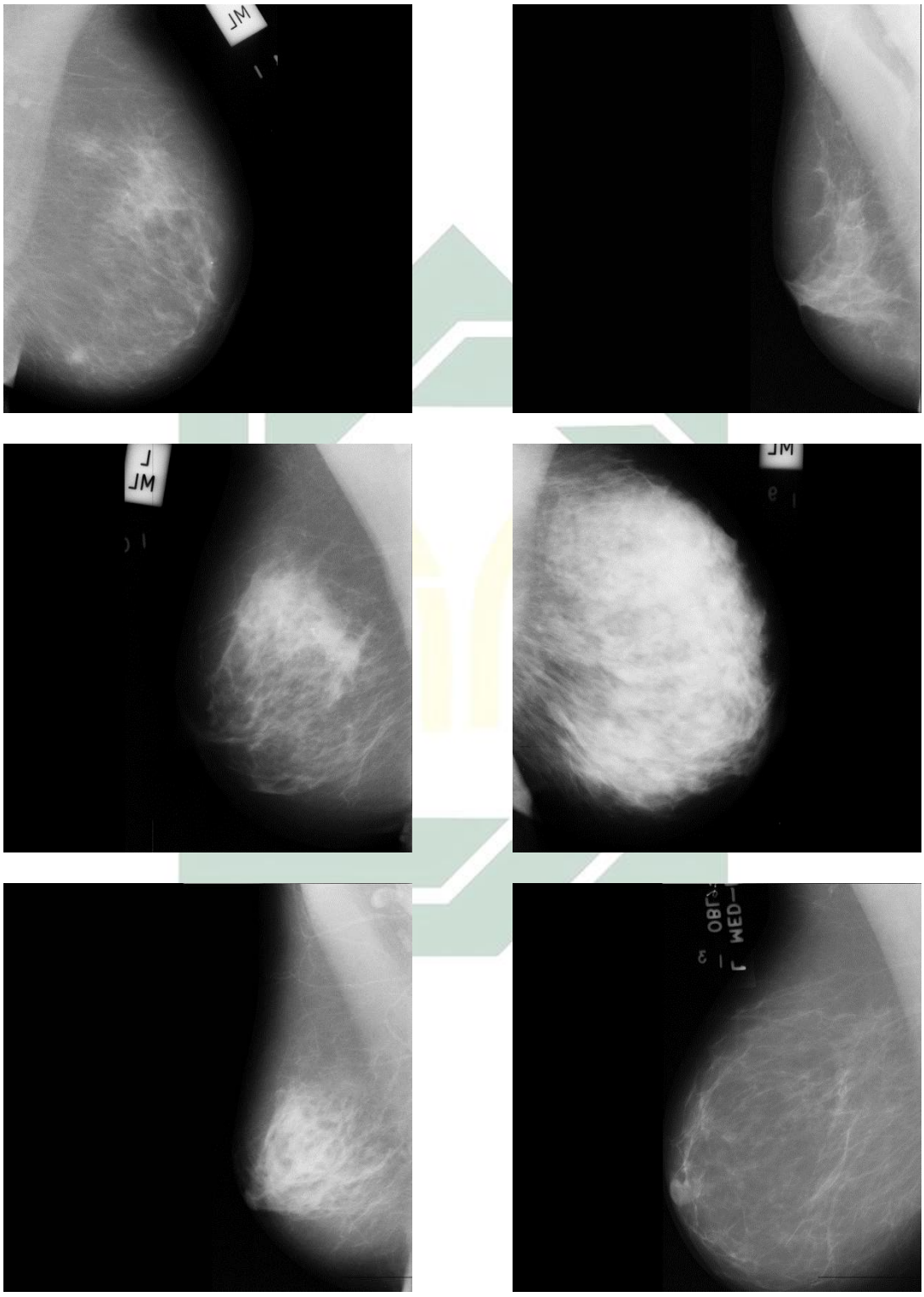


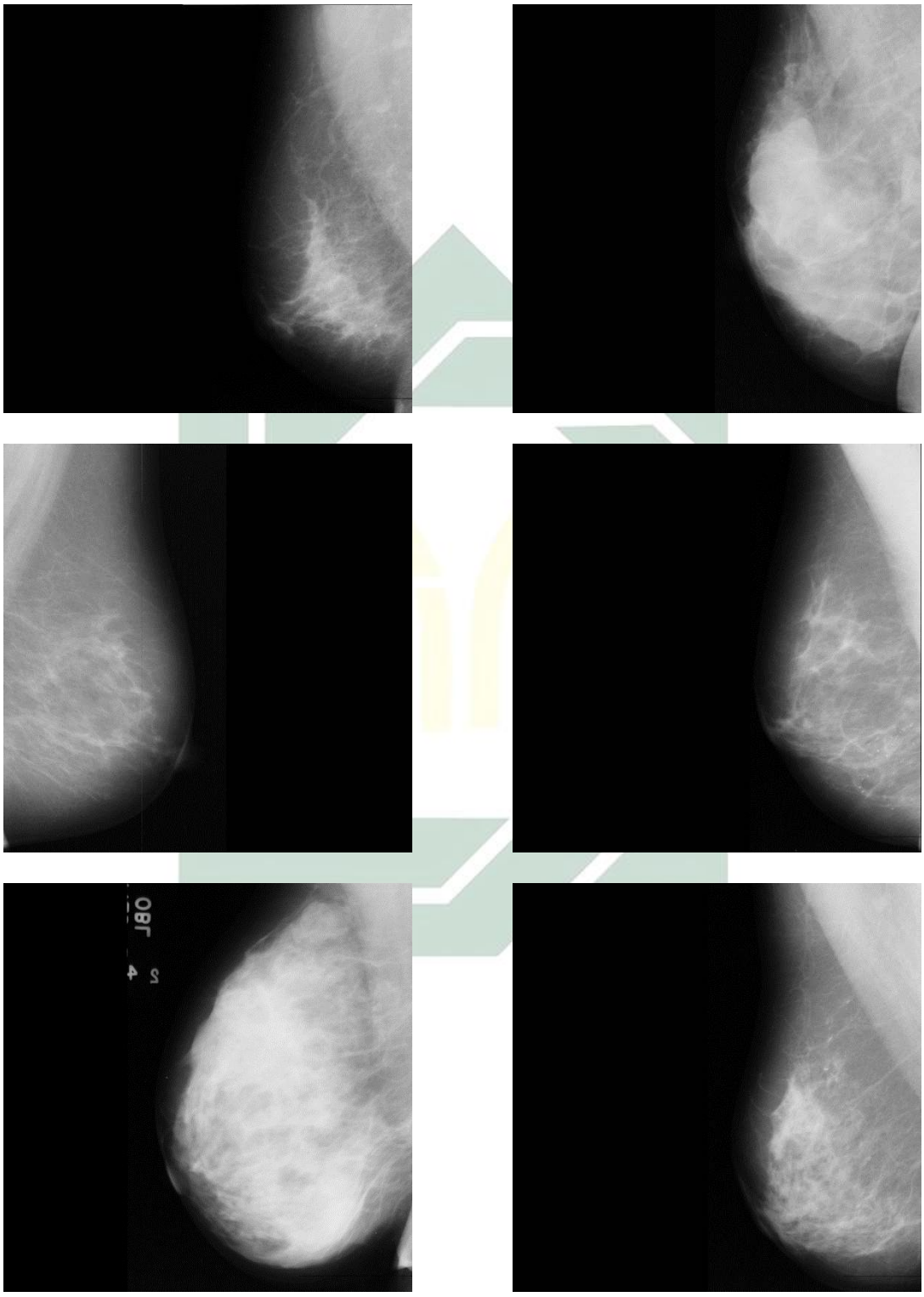


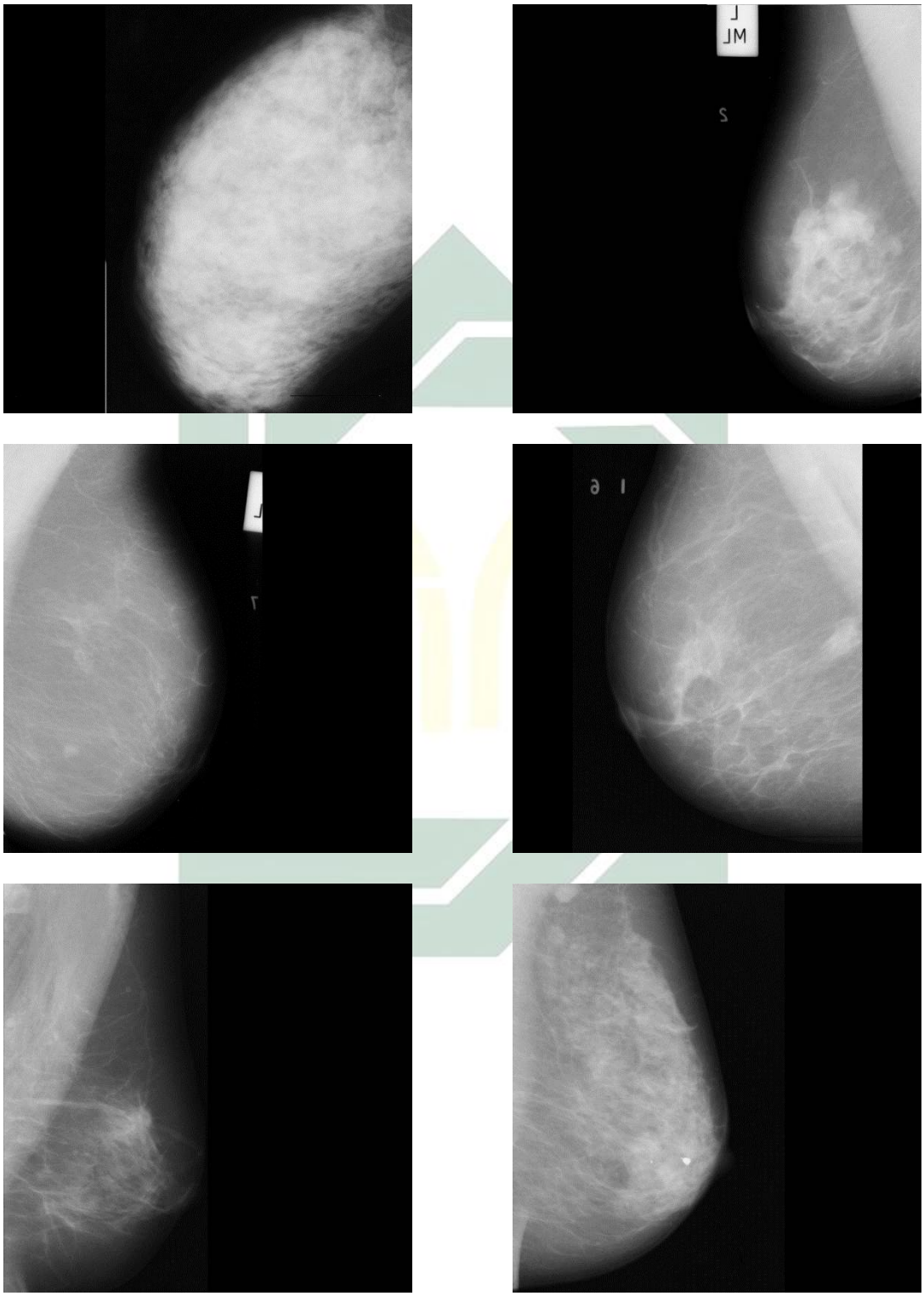


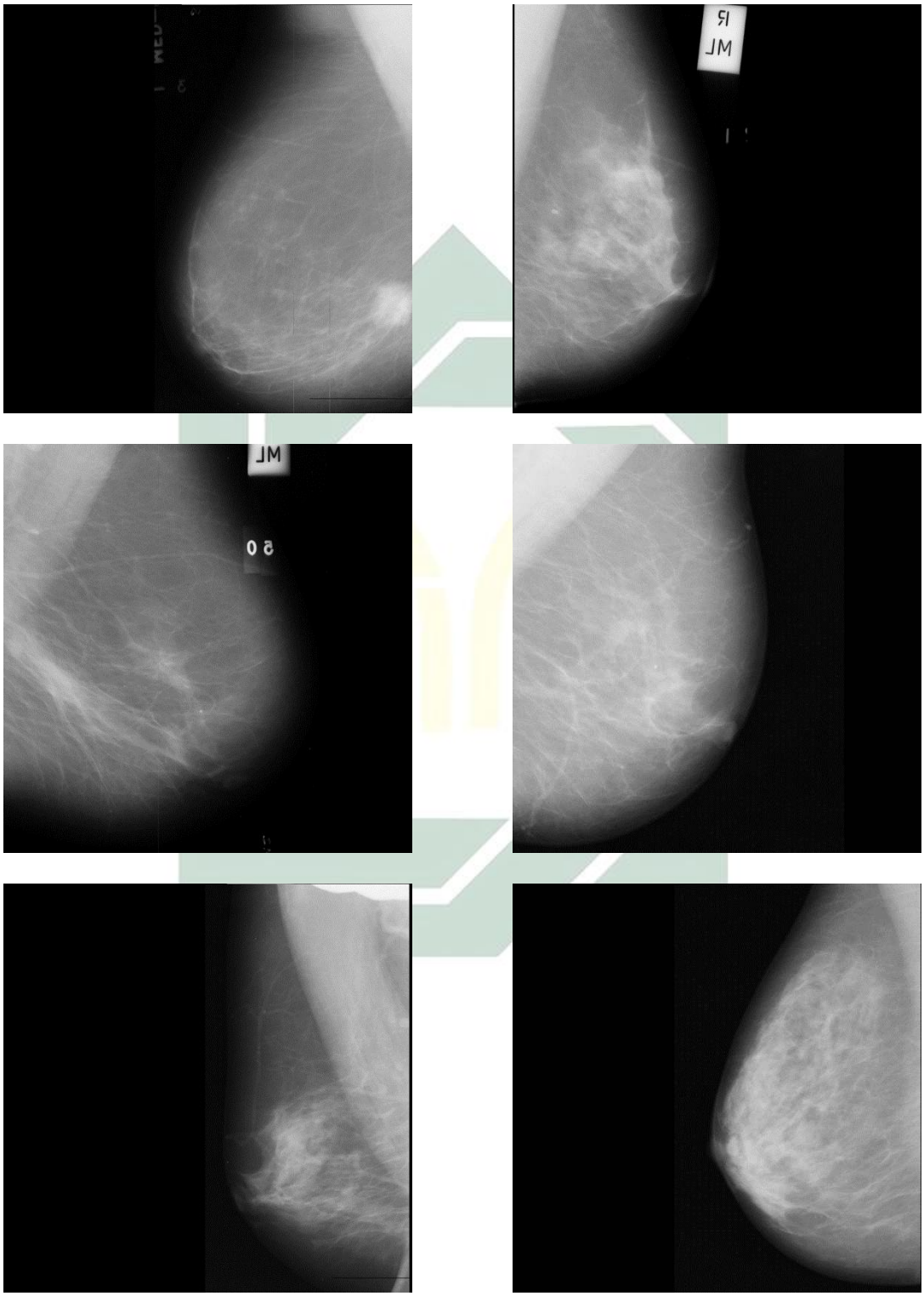


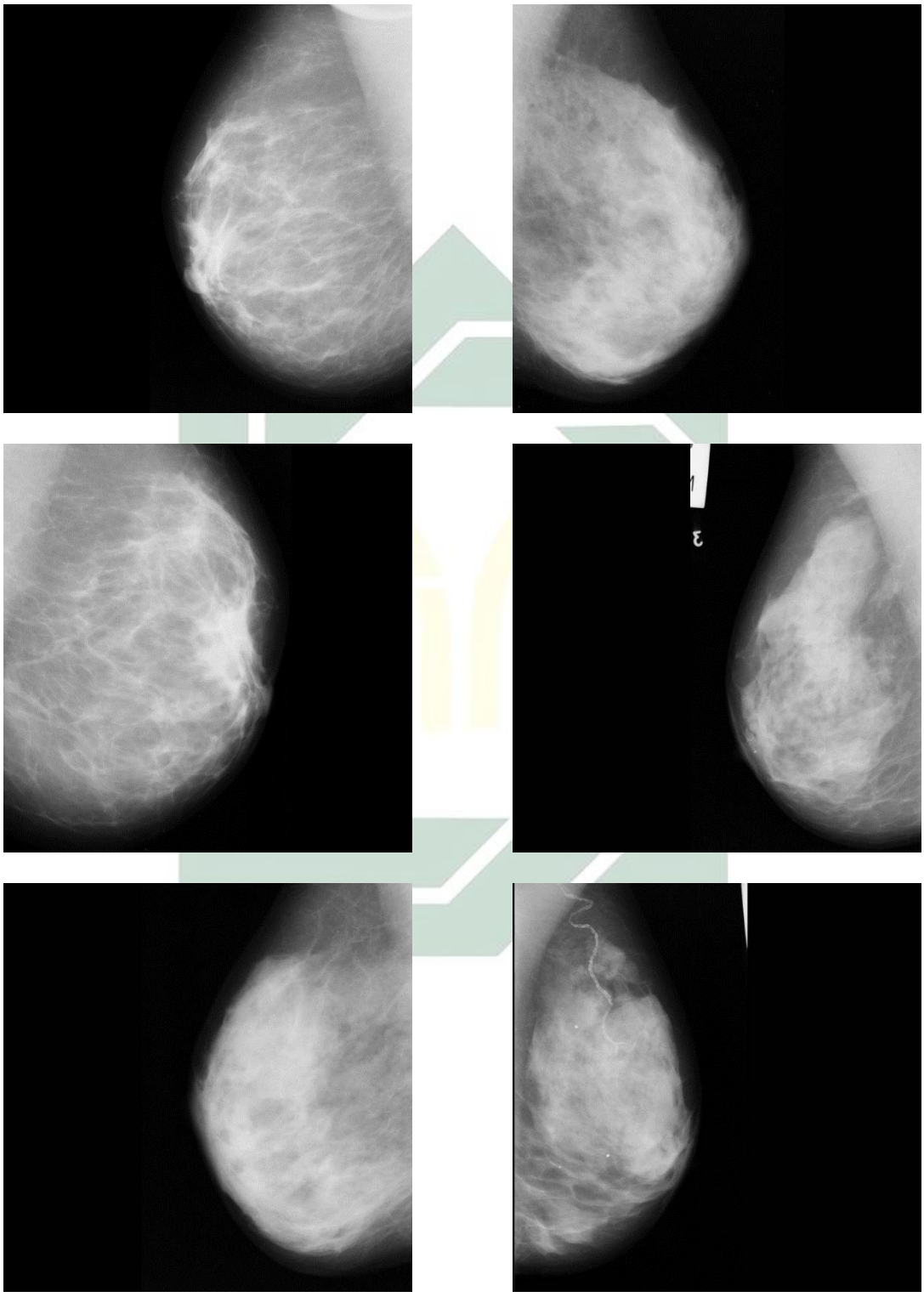


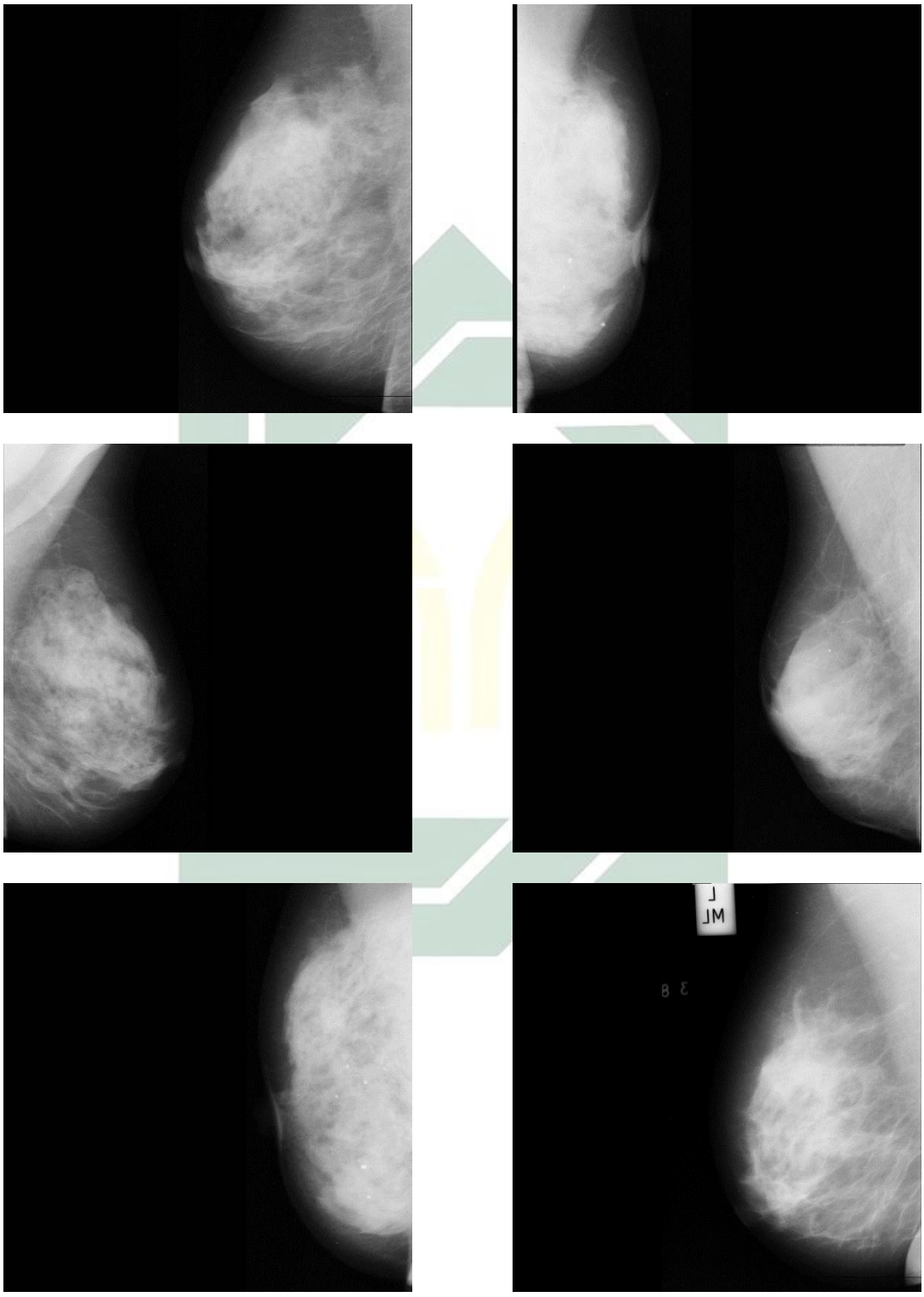


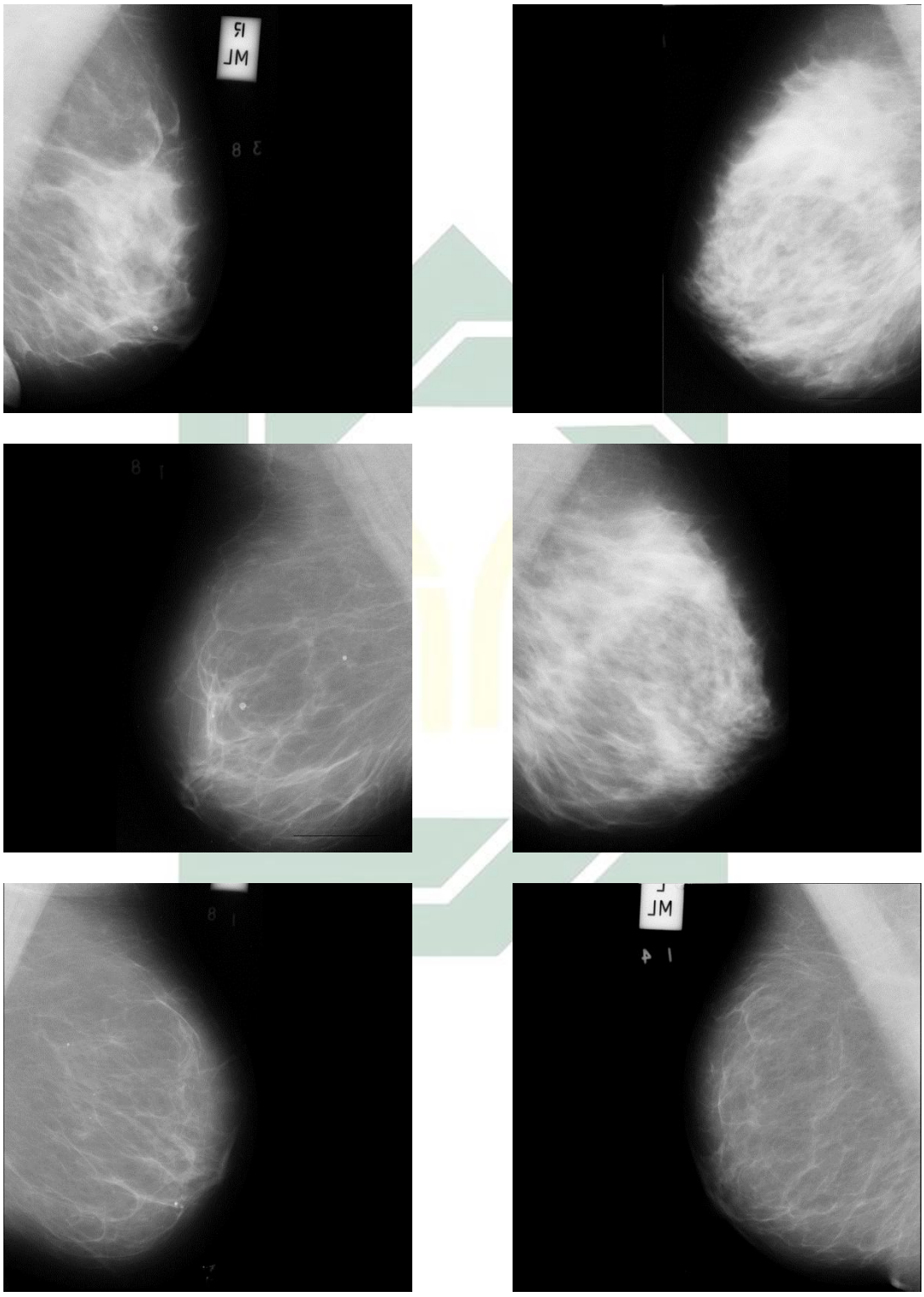


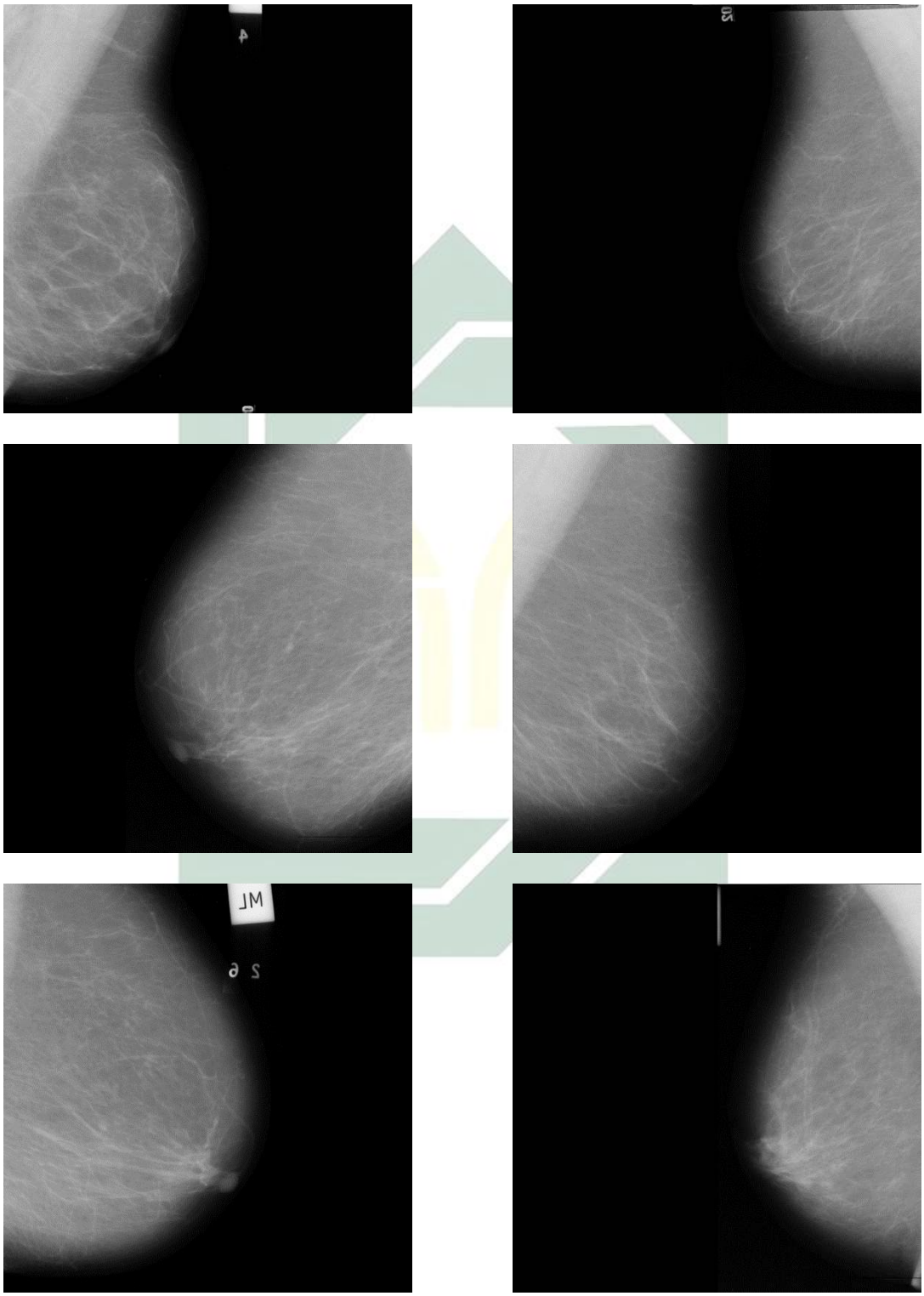


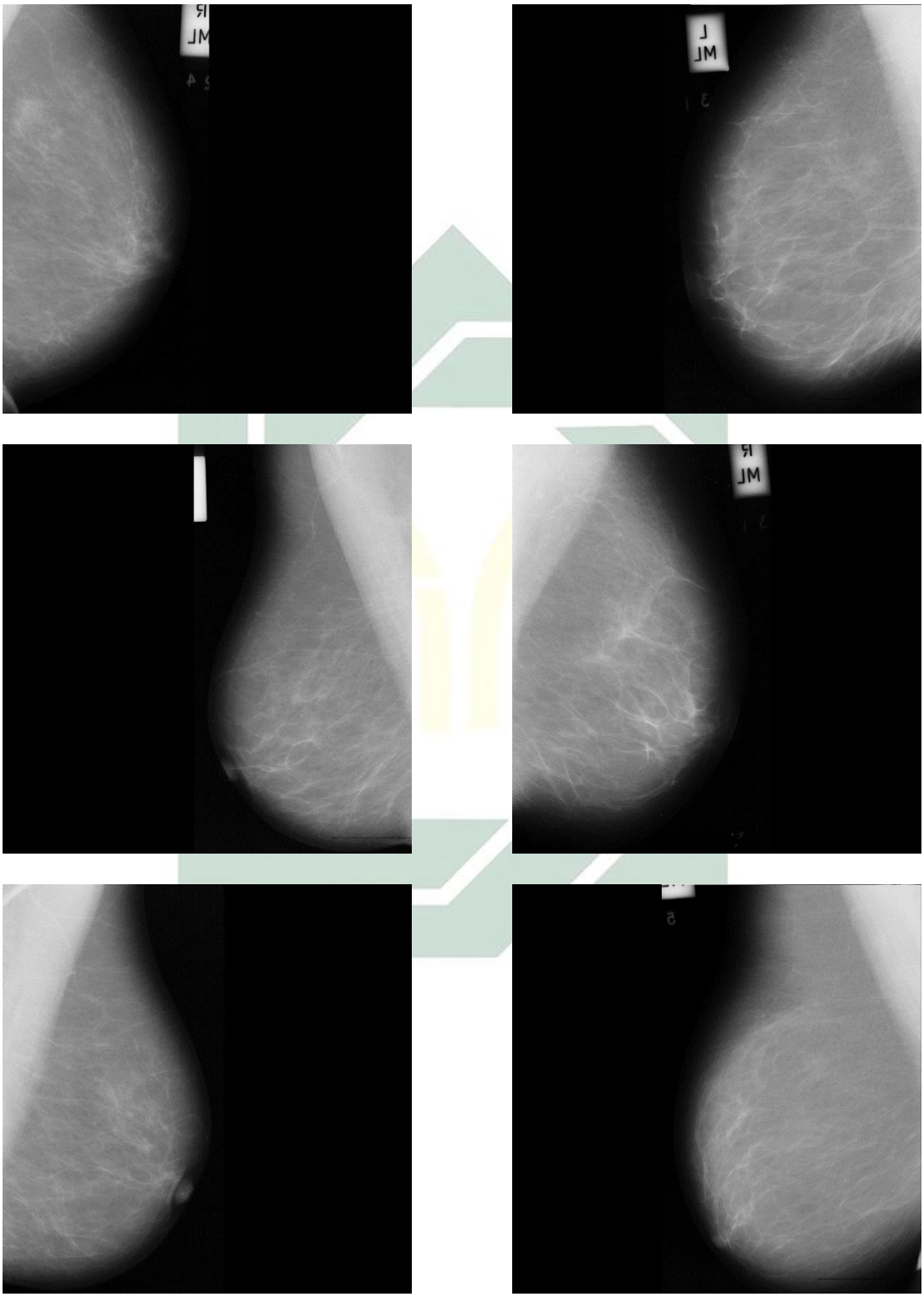


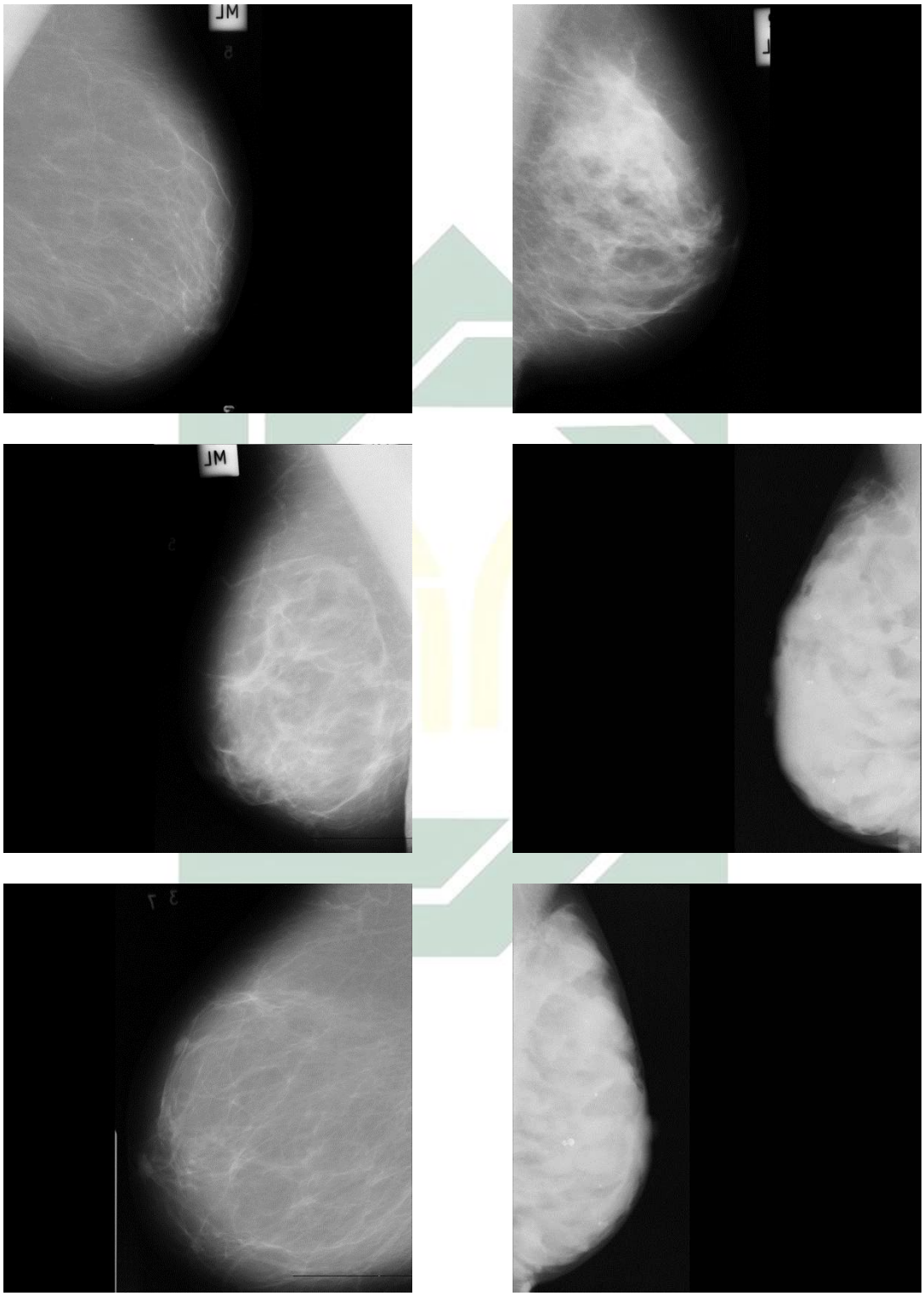


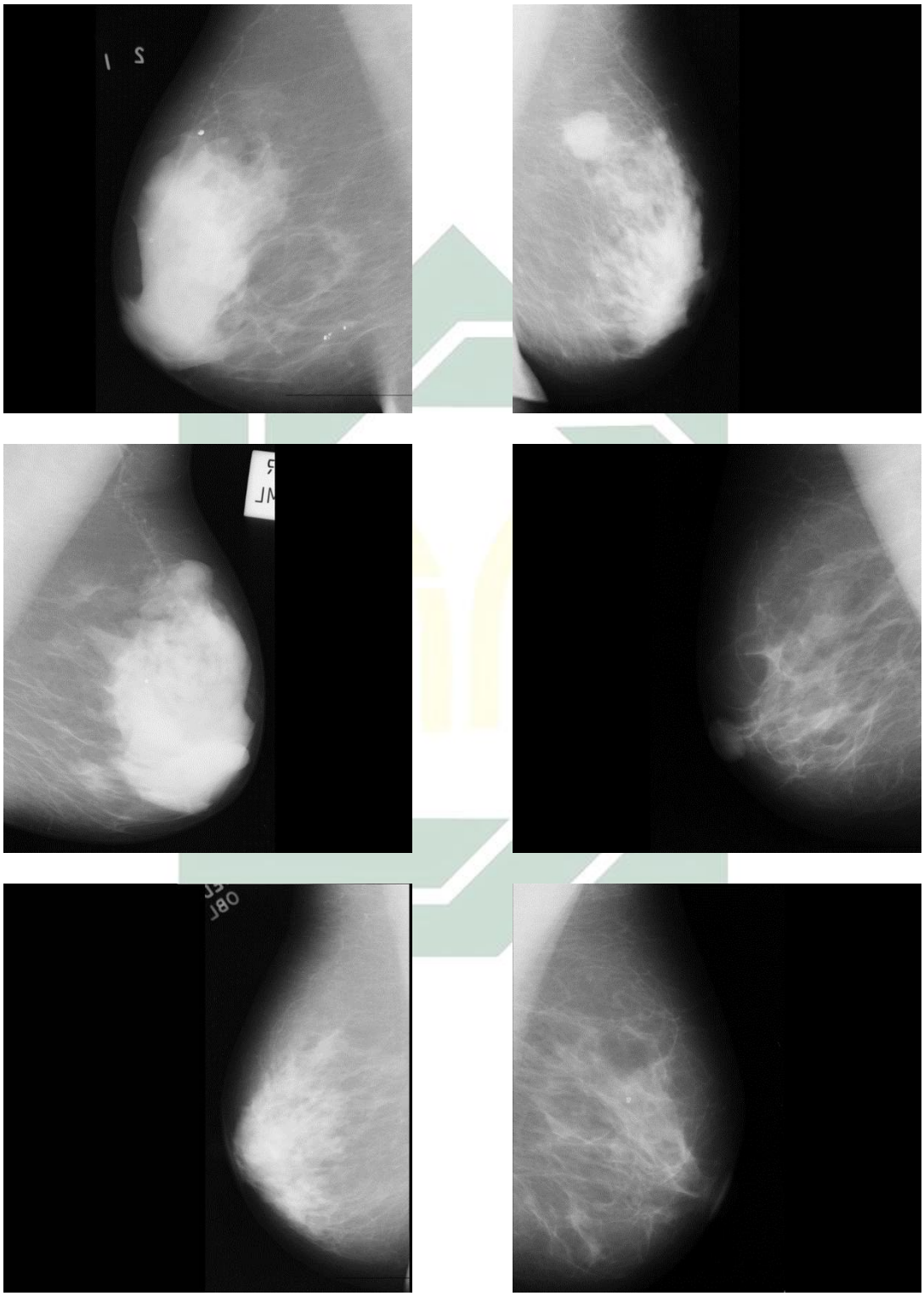


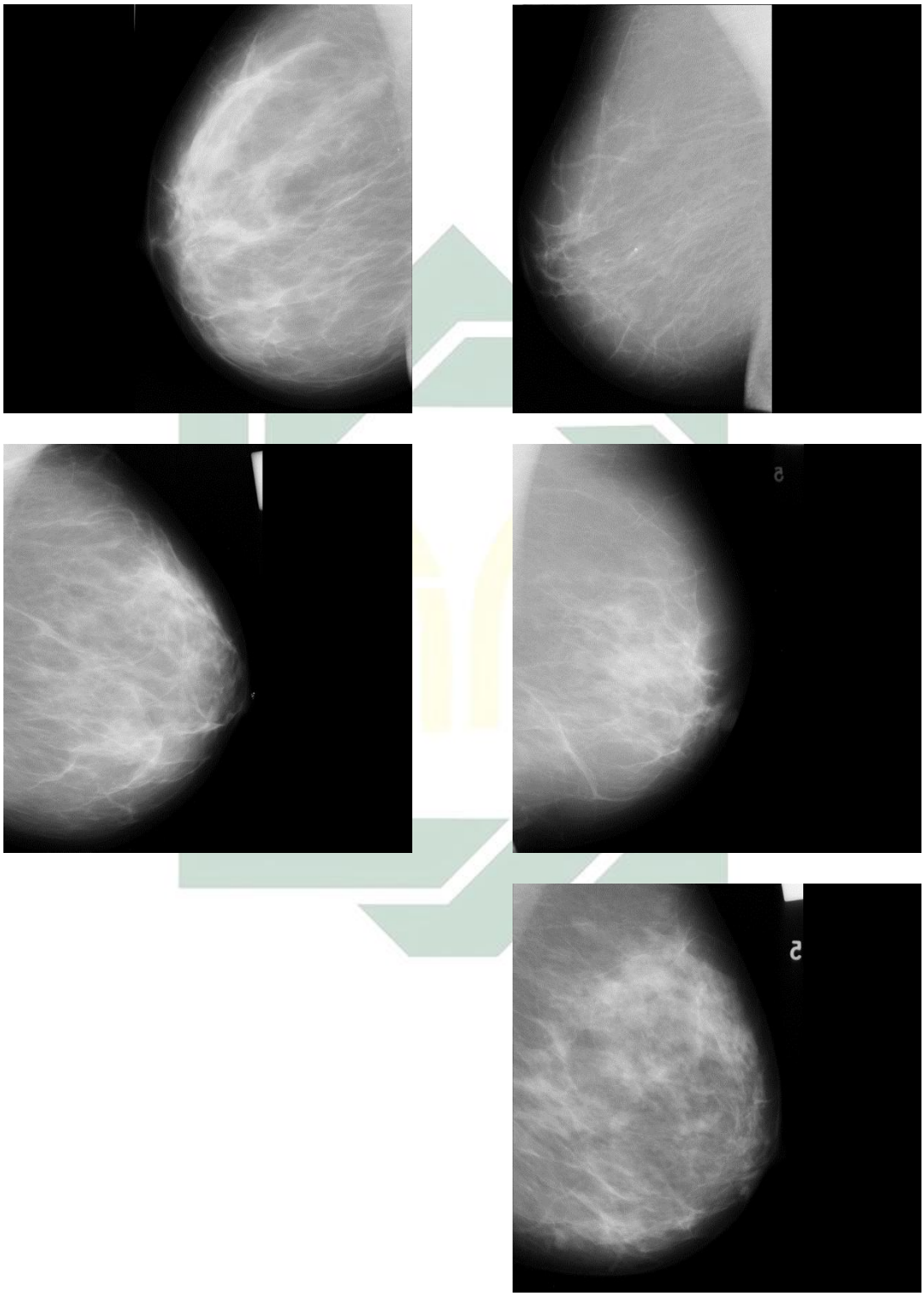


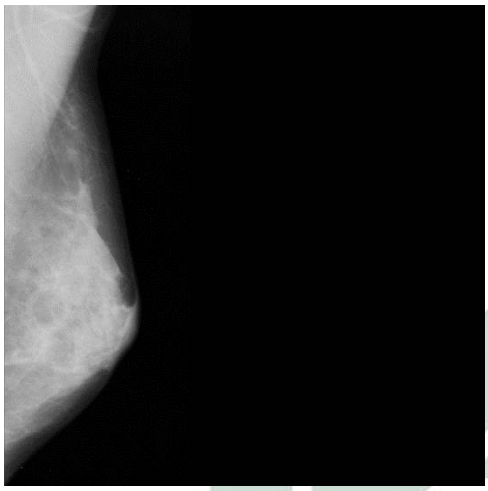
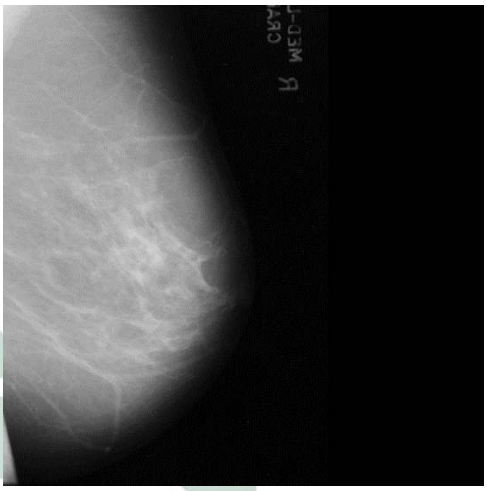




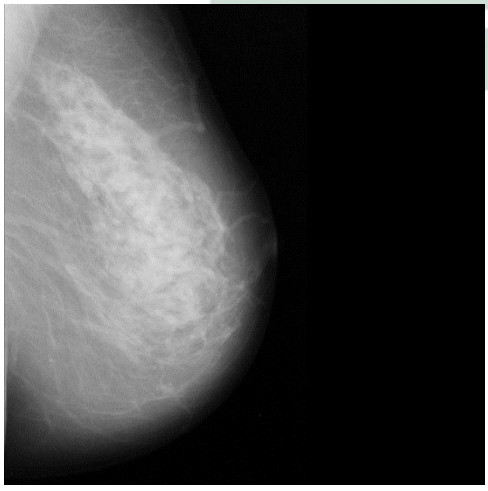










In the process, we divided the process in research into several stages such as data search, data processing and analysis of data processing. Here's a report the details of the process data.

Activity Name : Data Searcher Team

Name : Wahyu Tri Puspitasari

Activities : Finding cancer mammogram data and discussing cancer

Activity Results :

1) Breast Cancer

Breasts in men and women are the same until puberty (11-13 years) because the hormones estrogen and other hormones affect breast development in woman. In women the development of active breasts, whereas in men the mammary glands and ducts are less developed and the sinuses develop imperfectly. Breasts that are sensitive to hormonal influences cause the breasts to tend to develop neoplastic growth, both benign and malignant. Breasts are part of the reproductive organs whose main function is to secrete milk for infant nutrition. Breasts consist of structural tissue, Ebrosa which binds lobes, and fat tissue inside and between lobes. 85% of breast tissue consists of fat. A little below the center of the adult breast is a nipple (mamana papilla), a pigmented bulge surrounded by the areola. 23 Nipples and areola usually have different colors and textures than the surrounding skin. The color varies from pale pink to black and dark during pregnancy and lactation. Nipples usually protrude from the surface of the breast. Breast cancer can occur anywhere in the breast, but the majority occur in the outer upper quadrant where most breast tissue is present. In determining the location

of breast cancer, the breast is divided into four quadrants, namely the lateral quadrant (upper edge), lower lateral, medial (upper middle), and lower median. Breast anatomy and quadrant location of breast cancer can be seen in the picture below:

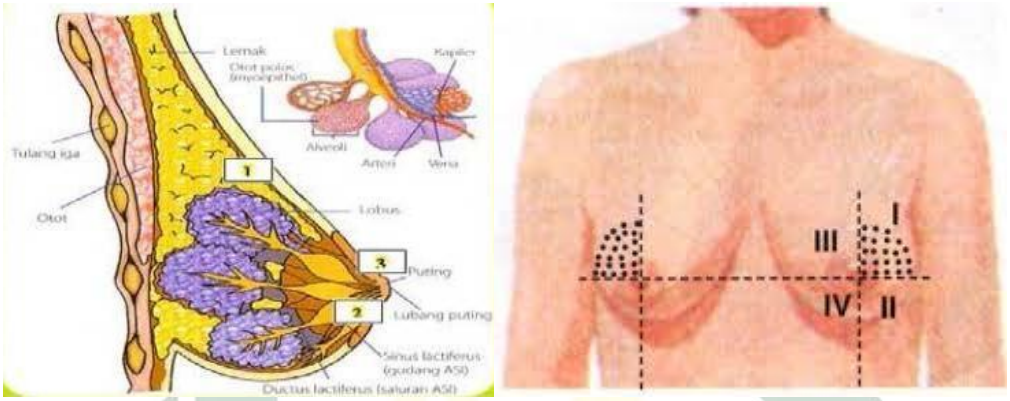


Figure 1. Breast Anatomy and Quadrant Breast Cancer Quadrant

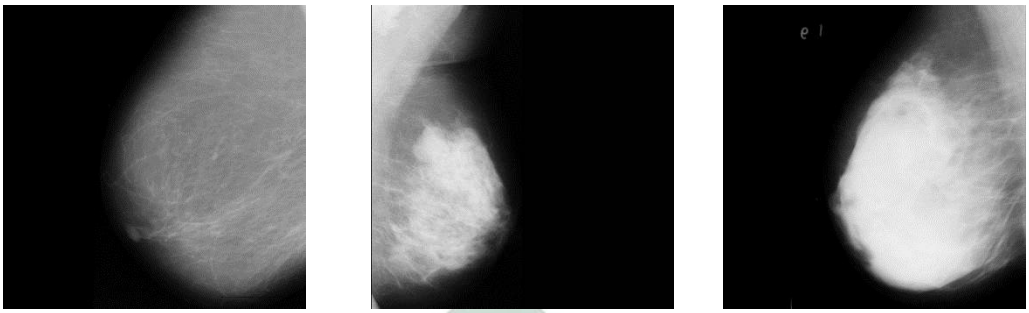
Description:

1. Corpus (body)
2. Areola
3. Papilla or Putting

I. Upper lateral (upper edge)
II. Lower lateral,
III. Upper medial (top center)
IV. Median under

2) Data Collection Data

used in the research are breast cancer mammogram images, where the data is in the form of gray scale images. The data is obtained from MIAS database. There are more than 300 mammogram images of breast cancer (normal image, tumor, cancer). This data processing is done by Wahyu Tri Puspitasari. The image of mammogram is shown as follows:



(a) (b) (c)

Figure 2. (a) Normal Mammogram Image (b) Mammograms of Benign Cancer or Tumors (c) Image of Mammogram Cancer

Activity Name : Data processing

Activities : Discussion of each method, and processing data according to the stages of the

Activity Results : In data processing several steps are carried out, namely pre-processing, feature extraction and classification. Sequentially performed by Putri Wulandari, Ahmad Zoebad Foeady, Muhammad Fahrur Rozi

Activity Name : Data processing

Name : Putri Wulandari

Activities : Discussion of initial processing on data (pre-processing)

Activity Results : Image data mammograms have different qualities, so an image improvement process is called a process pre-processing. In the pre-processing stage, several processes are carried out, namely Region of Interest, changing the image into a grayscale image and Adaptive Histogram Equalization.

1) Region of Interest (ROI)

Region of Interest is to give special treatment to the desired area at the time of image management. The principle of the Region of Interest is to limit the area to other regions. In the Region of Interest allows a different coding in certain areas and digital images, so that the resulting image is better quality than the surrounding area (background). The ROI feature results are very important because getting a certain part of the digital image is felt more important and the other part

Region of Interest (ROI) is very helpful for segmentation in image processing because using this technique the desired image or feature is easier to recognize. This is because in the Region of Interest (ROI) the features of the object will be divided into certain regions according to the image of the object

2) Grayscale

Initial processing of images presented in the distribution of gray images with pixel intensity values of 0 to 255 which value 0 as black and value 255 as white. Calculations for converting RGB images to grayscale are done by calculating the average value of the three Colors at each layer R, layer G, and layer B. Next Equation 2.1 is luminous for grayscale.

$$gs = \frac{(R + G + B)}{3}$$

Description:

gs: grayscale G: green

R: red B : blue

image Grayscale image has 256 gray levels with intensity of expertise with vulnerable values between 0-255. Gray intensity 0 is used for black, 255 for white, then 1-254 for gray.

3) Adaptive Histogram Equalization

Technique The histogram that is often used for histogram processing is histogram equalization (Histogram Equalization, HE) which is to produce a uniform or uniform histogram so that it is often referred to as histogram leveling (Gonzales, 2008). This technique can be done once for the entire image area (global histogram equalization) or with several times repeated for each image block (sub-image). Formula 2 is used to step up the histogram equalization process.

$$h\,(v) \;=\; round\left(\frac{cdf(v) - \; cdf_{min}}{(M \;\times\; N) - \; cdf_{min}} \times \; (L-1)\right)$$

Description:

v : the pixel value you want to replace.

cdf (v) : cumulative distribution function for value

Cdf_{min} : minimum value of cumulative distribution

MxN : pixel compiler image, with M number of columns and N number of lines

L : gray count that can be used, 8 bit gray image then L = 256

In Figure 3 is an example of image before and after the equalization process histogram. The appearance of the histogram equalization image has a better visual appearance. On the histogram, after the histogram equalization process, the process of

re-distribution of intensity occurs and becomes more evenly distributed. The intensity of 0 to 255 is almost all represented.

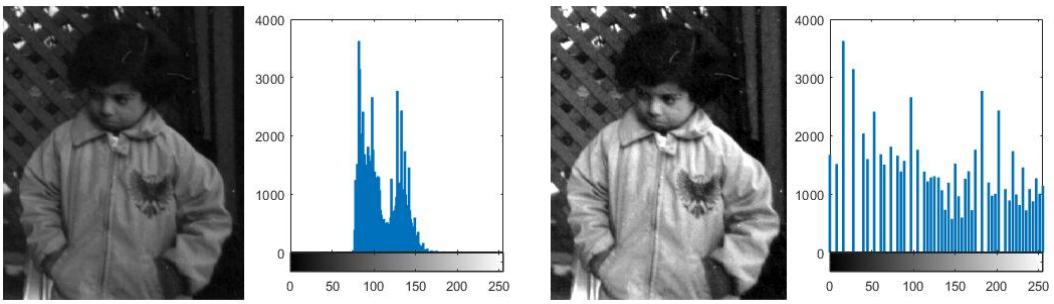


Figure 3. Image before and after equalization of histogram

Adaptive Histogram Equalization (AHE) technique is in principle the same as histogram equalization. Another name for AHE is local histogram processing (Gonzales, 2008), which is to apply the histogram equalization process several times each for each subimage block. Image block size has been determined according to the condition of the image or research needs, namely between 230, 4x4, 8x8, l6x6 6 pixels, or other sizes. The AHE technique and its variations were introduced by Pizer and colleagues (1987). They researched and applied the AHE technique to natural images and medical imaging. Here the object can look better because of the contrast repair process. In addition, the computational time needs were also examined. Another study by Stark (2000) which examined the use of AHE techniques based on contrast stretching. Modifications were also made to variations in contrast stretching besides the image block size. This variation affects the results of improving image quality.

The first step in pre-processing is the process of Region of Interest (ROI) in the form of cropping on the tumor area. The goal is that the image is focused on the tumor

area only. The grayscale process is then carried out, namely the process of converting RGB images into gray or grayscale images. After obtaining the grayscale image the image enhancement process is focused on the adaptive histogram equalization because the mammogram image has a different spread of pixel intensity. Next is the feature extraction process.

Activity Name : Data processing

Name : Ahmad Zoebad Foeady

Activity : Discussion of the Hidden Markov model for the feature extraction process

Activity Results : Before the classification process is carried out a feature that is used as input in classification is required. To get the features of the image, feature extraction is required. One feature extraction method is the Hidden Markov Model (HMM). Before feature extraction, a double thresholding process was performed to obtain tissue that presented a tumor or cancer.

1) Double Thresholding

Thresholding is an important part of image segmentation, where it is necessary to isolate objects from the background can be illustrated simply by selecting two pixel values L and U from the image, where L is the lower limit of thresholding and U is the upper limit of thresholding, and applying operation thresholding as: A pixel becomes white if the gray level is between L and U, and black if the gray level is the opposite. The result is a binary image (black and white), white for all levels of gray pixels is

between two boundaries of L, U, and black values for the other For each image we work on, we have to determine almost the pixel value for the area we need to scope, and choose a better thresholding limit for better extraction for the area needed ... For sample mammograms included in this study, after many trials selected L = 0.75 & U = 0.96.

2) Hidden Markov

Hidden Markov Model The model is the development of statistical models of Markov models. This model was developed by Andreyevich Markov. The Hidden Markov Model is a statistical model that is modeled system is assumed to be a Markov process with unknown parameters and hidden parameters must be determined from the observable parameter.

In the ordinary Markov model, state (x) is directly visible to the observer. Therefore, the probability of the transition is the only parameter. Hidden Markov The model has been studied extensively in various fields of statistics. This model is seen as a parametric bivariate process in discrete time. The process occurring in Hidden Markov The model is a homogeneous finite state of the Markov model and cannot be observed.

Before the HMM process identification of breast tissue is done. After the image is identified, one of the tissues that represents the tumor or cancer is selected. The network will be used as input in the feature extraction process using HMM. This process produces several futures. This feature will be used as input in the classification using modified backpropagation.

Activity Name : Data processing

Name : Muhammad Fahrur Rozi

Activity : Discussion of the modified backpropagation method

Activity Results : The features obtained from the feature extraction process are used for input in the classification using modified backpropagation. Following is the explanation of the modified backpropagation method.

Artificial Neural Networks with multilayer (Multilayer Perceptron) to change the weights connected to all neurons in the hidden layer. Backpropagation algorithm developed in 1986 by Rumelhart, Hinton, and Williams. Backpropagation algorithm uses output errors by changing the value of weights in the backward direction.

The basic principle Backpropagation algorithm consists of three vases, namely:

a. *Feed forward*

this phase is the calculation phase of activation value. Each neuron in the hidden layer and output layer calculates each activation value according to the activation function used.

b. Calculation Phase and *Backpropagation error*

Each output neuron calculates the error information between the target value and the resulting output. The information will be sent to the layer below.

c. Weight adjustment phase

Any output of neurons and hidden neurons changes the bias and weights according to the error values

In addition, Characteristic of Artificial Neural Networks are:

a. Multilayer Network

In this network, the architecture used is one input layer, one output layer, and one hidden layer. Every neuron on a single layer in Backpropagation gets an input signal coming from all neurons on the previous layer along with a bias signal.

b. Activation Function.

This function is required to be continuous, differentiable, and not descent. This function used Backpropagation JST:

1) *Sigmoid binary* function that output interval is [0,1]

$$y = f(x) = \frac{1}{1+e^{\sigma x}} \quad (2.1)$$

with $f' = \sigma f(x)[1 - f(x)]$

2) *Signoid bipolar* output function has interval [-1,1]

$$y = f(x) = \frac{1-e^{-x}}{1+e^{-x}} \quad (2.2)$$

with $f'(x) = \frac{\sigma}{2}[1 + f(x)][1 - f(x)]$

Figure 4 shows Backpropagation Artificial neural network model (ANN) model with one hidden layer.

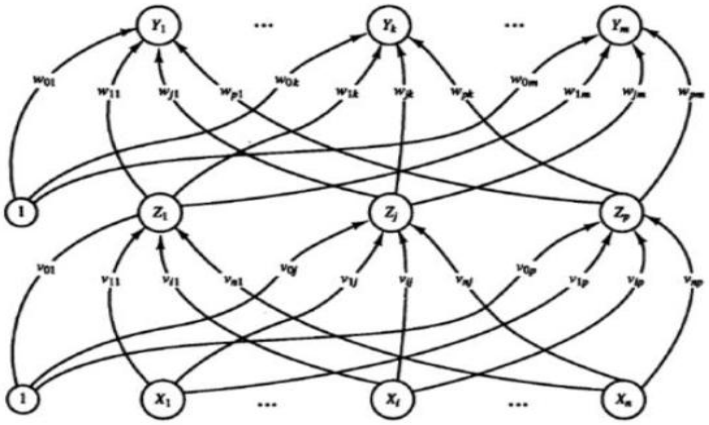


Figure 4. Backpropagation ANN Architecture

The steps of the backpropagation algorithm are taken as follows:

1. Initialization of weights (take initial weight with a small enough random value).
2. Do the following steps until the condition is stop or *FALSE*
   a. For each pair of training the data do the following steps:

Feedforward:

1) Each input unit (x_i, i = 1, 2, 3, ..., n) receives the signal x_i and the signal to all units on each layer above (hidden layer).
2) Each hidden unit $z_j, j = 1,2,3,\ldots,p)$ sums the weighted input signals into the following equation:

$$z_{in_j} = v_{0j} + \sum_{i=1}^{n} x_i v_{ij} (2.3)$$

use activation function to calculate output signal:

$$z_j = f\left(z_{in_j}\right) \quad (2.4)$$

send the signal to all units in the layer above.

3) Every output unit($Y_k, k = 1,2,3,\ldots$,m)weighted sums of input signal using:

$$y\_in_k = w_{0k} + \sum_{i=1}^{p} z_j w_{jk} \quad (2.5)$$

use the activation signal to calculate the output signal:

$$y_k = f\,(y\_in_k) \quad (2.6)$$

and sent the signal to all units in the above layer.

Backpropagation

4) Every output unit ($Y_k, k = 1,2,3,\ldots,m$) will receive the target pattern associated with the learning input pattern, then calculate the error information with:

$$\delta_k = (t_k - y_k)\, f'\,(y\_in_k) \quad (2.7)$$

Then calculate the weight of correction (which will be used to fix the value of $w_{jk)}$,this calculation uses:

$$\Delta w_{jk} = \alpha\, \delta_k\, z_j \quad (2.8)$$

Calculate the correction of its bias values to improve the value of w_{0k} using:

$$\Delta w_{0k} = \alpha \delta_k \quad (2.9)$$

send δ_k to the existing units under the lining.

5) Every hiden unit($z_j, j = 1,2,3,\ldots$,p)sums result on the layer units above by

$$\delta\_in_j = \sum_{k=1}^{m} \delta_k w_{jk} \quad (2.10)$$

Then multiplies the value with the differential of its activation function to calculate the error value information:

$$\delta_j = \delta_{in_j} f'(z\_in_j) \quad (2.11)$$

Then calculate the value of service for fixing the value of

$$v_{ij} : \Delta v_{jk} = \alpha \delta_j x_i \quad (2.12)$$

Then calculate the value of bias that will be used to improve the value v_{oj} using:

$$\Delta v_{0h} = \alpha \delta_j \quad (2.13)$$

6) Every output unit($Y_k, k = 1,2,3,\ldots$,m)will improve the value of bias and weight of($j = 0,1,2,\ldots$,p):

$$w_{jk}(new) = w_{not}(long) + \Delta w_{jk} \quad (2.14)$$

Every hidden unit ($z_j, j = 1,2,3,\ldots,p$) serves to improve the value of bias and its weight ($i = 0,1,2,\ldots,n$):

$$v_{ij}(new) = v_{ij}(old) + \Delta v_{ij} \quad (2.15)$$

b. Test until stop

Features obtained from the Ether extraction process are used as input in modified backpropagation. The data will be classified into two classes, namely normal, tumor and cancer. The breast cancer diagnosis scheme is shown below.

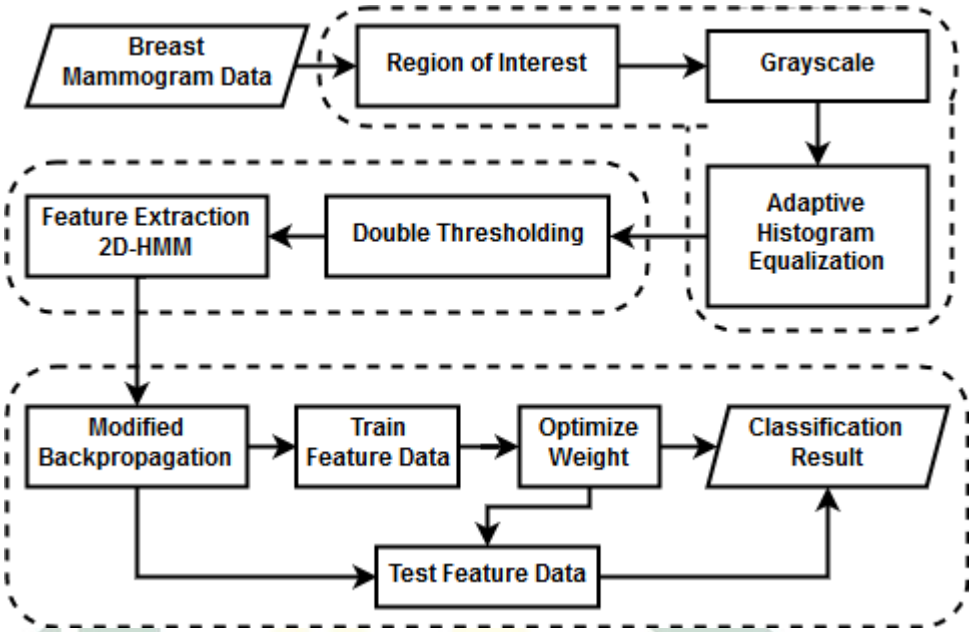


Figure 5. Automatic Breast Cancer Diagnose Flowchart System

Figure 5 represents:

- Breast image data is mammography data from multiple data samples
- Breast cancer mammogram data is gray image data (gray image)
- From gray scale mammography data applied adaptive histogram equalization
- Then thresholding
- Next goes into feature extraction, selection features using the hidden markov model by dividing the HMM parameters into HMM training and HMM testing.
- HMM training and testing results classified using Backpropagation.
- Selection features using the hidden markov model by the dividing the HMM parameters into HMM training and HMM testing.
- HMM training and testing result classified using Backpropagation.

The classification is divided into three categories, normal and abnormal, mass and micro classification, benign and malignant using modified backpropagation.

5. Activity Name : Data Analysis

   Name : Deasy Alfiah Adyanti, S.Mat

   Activities : Analyzing data in the pre-processing program

   Activity Results : The pre-processing process is done using MATLAB because the images used are very large. A function has been provided for several pre-processing methods. Like *RGB2scale*, *adapthisteq*, etc. But not all methods have been provided in MATLAB. The following is the source code in MATLAB for the pre-processing process.

```
clc; clear; close all;
mammo = 'D:\Download\mias-mammography';
form  = dir(fullfile(mammo,'*.pgm'));
n     = numel(form);
for i = 1:n
    file_name = fullfile(mammo, form(i).name);
    imgbm{i}  = imread(file_name);
    imr{i}    = imresize(imgbm{i},0.25);
    posisi{i} = posisi{i}(:,:)./4;
    roitb{i}  = roipoly(imr{i},posisi{i}(:,1),posisi{i}(:,2));
    img{i}    = regionfill(imr{i},imcomplement(roitb{i}));
    OutName   = sprintf('ImageCrop #%d.pgm', i);
    folderName= fullfile(mammo, OutName);
    imwrite(img{i}, folderName);
end
```

1

```
for n = 1:total_images2
    if n<=total_images
        i=n;
       full_name = fullfile(image_folder, filenames(i).name);
    elseif n <= total_images1
        i=n-total_images;
       full_name = fullfile(image_folder1, filenames1(i).name);
    else
        i=n-total_images1;
       full_name = fullfile(image_folder2, filenames2(i).name);
    end
end


haha    = fullfile(image_folder1, filenames1(11).name);
gambar = imread(haha); figure; imshow(gambar);title('mammogram image');
grayim = rgb2gray(gambar);figure; imshow(gambar);title('gray scale image')
clahe   = adapthisteq(grayim);figure; imshow(clahe);title('Adaptive Histogram Equ
pembagi= double(grayim)*(1/256);
```

2
3

Figure 6. Pre-Processing Source Code using MATLAB

1 → Cut the image of a mammogram.

2 → Change the RGB image to be grayscale.

3 → The adaptive histogram equalization process.

The results of the Region of Interest and gray scale can be shown in Figure 7.

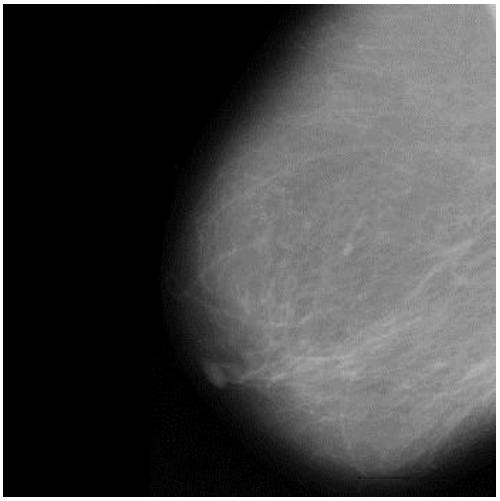


Figure 7. Result of Pre-Processing

Next changes the RGB image to grayscale. The Process gray scale aims to convert the RGB image into a gray image so that the pixel range is smaller and easier to proceed to the next process. This process is done because the mammogram result image has a pixel color value (Red, Green, Blue) so it must be grayscale so that the pixel value of the image is easy to process. Suppose the breast cancer mammogram image with the number of pixels in color (Red, Green, Blue) is 15333, then the image is converted into image grayscale with the following equation.

$$gs = \frac{(R + G + B)}{3}$$

$$gs = \frac{15333}{3} = 5111$$

Number of gray pixels obtained is 5111 with a range of gray pixels worth 0-255 which is between black pixel values close to 0 and white approaches the value 255. Next is done adaptive histogram equalization process.

The mammogram image used as the object of discussion is of poor quality. Therefore, the process adaptive histogram equalization aims to obtain a uniform histogram spread, so that every degree of gray image of the mammogram has a relatively equal number of pixels. Adaptive histogram equalization is the development of the histogram equalization method so that the results of the spread of the histogram of the image degree are more evenly distributed and relatively the same.

The results of the applied adaptive histogram equalization process shown in Figure 8.

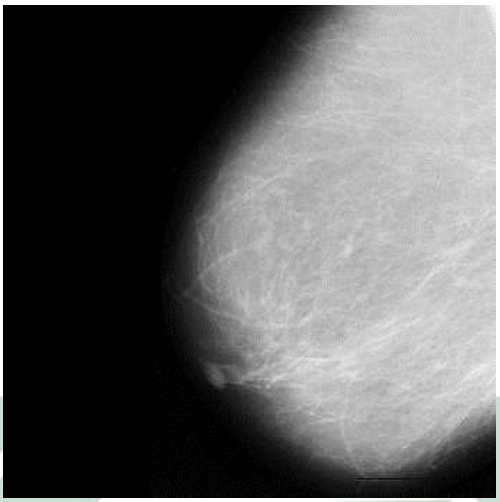


Figure 8. The results of the applied adaptive histogram equalization process

6. Activity Name: Data Analysis

   Name : Ahmad Hanif Asyhar, M. Si

   Activities : Analyzing data on the Hidden Markov program Model

   Activity Results : The process of the Hidden Markov Model is done using MATLAB. Previously, the network identification process was carried out and chose a network that represented tumors and cancer. In this study using a double threshold for the process of identifying and selecting networks. The following is the source code for the double threshold using MATLAB.

```
[o p] = size(pembagi);
T1 = 0.75;
T2 = 0.96; % thresholds

for i = 1:o
    for j = 1:p
        if pembagi(i,j)>T1 && pembagi(i,j)<T2
            original(i,j)=0; %changes to white image
        else
            original(i,j)=1; %changes to white black
        end
    end
end
hasil_treshold=imcomplement(original); figure; imshow(hasil_treshold);title('Thresholding')
```

Figure 9. Thresholding Source Code using MATLAB

The results of the thresholding process are shown in Figure 10.

Figure 10. Result of Thresholding

Next is the Hidden Markov Model (HMM) process.

7. Activity Name: Data Analysis

   Name : Nurissaidah Ulinnuha, M.Kom.

   Activity : Analyzing data in the modified backpropagation program

   Activity Results : Prose classification using modified backpropagation was done using MATLAB. Some features that have been obtained from HMM are used as input in the classification process. The following is the source code training data with modified backpropagation using MATLAB.

```
load hasilpre.mat P T
fprintf('training dimulai\n')
 JumPola   = length(P(:,1));
  DimPola   = length(P(1,:));

  [a,b] = size(T)
  for i = 1:a
      if T(i,1) == 1
          T(i,1) = 0.001;
      else
          T(i,1) = 0.999;
      end
  end
  JOneuron  = length(T(1,:));

  JHneuron1 = 80;
  LR = 0.4;
  Epoch = 2000;
  MaxMSE = 0.001;

  % ------------------------------------------------------------
  % Bangkitkan Weights antara Input dan Hidden Layer secara acak
  % ------------------------------------------------------------
  CB = 0.5;
  LD = 0.0001;
  E3 = 0.1;
  JHneuron2 = 40;

  Skala = 0.7 * (JHneuron1^(1 / DimPola ));
  W1 = (-0.5) + (0.5 - (-0.5)).*rand(JHneuron1,DimPola);W1 = W1';
  % ==== inisialisasi nguyen-widrow ====
  VH = zeros(JHneuron1,1);
  for i=1:JHneuron1
      VH(i) = norm( W1(:,i));
  end

  W1 = Skala * W1;
  for i=1:JHneuron1
      W1(:,i) = W1(:,i)/VH(i);
  end
  % ===================================
  B1 = ((-1) * Skala) + (Skala - (((-1) * Skala))).*rand(1,JHneuron1);

  W2 = (-0.5) + (0.5 - (-0.5)).*rand(JHneuron2,JHneuron1); W2 = W2';
  B2 = (-0.5) + (0.5 - (-0.5)).*rand(1,JHneuron2);

  W3 = (-0.5) + (0.5 - (-0.5)).*rand(JOneuron,JHneuron2); W3 = W3';
  B3 = (-0.5) + (0.5 - (-0.5)).*rand(1,JOneuron);

  MSEepoch = MaxMSE + 1;
  MSE = zeros(1,Epoch);
  ee = 0;
  fprintf('masuk perulangan\n')
  while (ee < Epoch) && (MSEepoch > MaxMSE)

      ee = ee + 1;
      %MSE_NonLinear = 0;
      MSE_Linear = 0;

      % choose neighborhood
      ch_nei = floor(rand(1) * 2);

      for pp=1:JumPola

          CP = P(pp,:);
          CT = T(pp,:);

          % feedforward
          Z1 = zeros(1,JHneuron1);
          for i= 1:JHneuron1
              Z1(i) = tansig( CB * B1(:,i) + CP * W1(:,i) );
          end

          Z2 = zeros(1,JHneuron2);
          for i= 1:JHneuron2
```

```
        Z2(i) = tansig( CB * B2(:,i) + Z1 * W2(:,i) );
    end

    Y = zeros(1,JOneuron);
    Y_in = zeros(1,JOneuron);
    for i= 1:JOneuron
        Y_in(i) = CB * B3(:,i) + Z2 * W3(:,i);
        Y(i) = logsig( Y_in(i) );
    end

    % perhitungan nonlinear and linear error
    e1_o = CT - Y;                          % nonlinear error
    e2_o = ( log(CT)-log(1-CT) ) - Y_in; % linear error

    for i=1:JOneuron
        %MSE_NonLinear = MSE_NonLinear + e1_o(i)^2;
        MSE_Linear    = MSE_Linear + e2_o(i)^2;
    end
    %MSE_NonLinear = 0.5 * MSE_NonLinear;
    %MSE_Linear = 0.5 * LD * MSE_Linear;
    MSE_Linear = 0.5 * MSE_Linear;

    % backpropagation of error

    if (ch_nei == 0)
        nh1_a = 1;
        nh1_b = floor(JHneuron1/2) - 1;
        nh2_a = 1;
        nh2_b = floor(JHneuron2/2) - 1;
    else
        nh1_a = floor(JHneuron1/2);
        nh1_b = JHneuron1;
        nh2_a = floor(JHneuron2/2);
        nh2_b = JHneuron2;
    end
    fprintf('masuk hidden layer dan output\n')
    % ========== hidden - output ============================

    dk1_o = zeros(1,JOneuron);
    for i = 1:JOneuron
        dk1_o(i) = e1_o(i) * Y(i) * (1 - Y(i));
    end

    dW3 = zeros(JHneuron2,JOneuron);
    delta3 = zeros(1,JOneuron);
    for i = nh2_a:nh2_b
        for j = 1:JOneuron
            adf = norm( Y(j) * (1 - Y(j)) * Z2(i) * e1_o(j) )^2 + E3;
            delta3(j) = (1/adf) * ((LR * norm(e1_o(j))^2) * dk1_o(j) * Z2(i) + LD * e2_o(j) * Z2(i)↙
);
        end
        dW3(i,:) = delta3;
    end

    bias3 = zeros(1,JOneuron);
    for i = 1:JOneuron
        adf = norm( Y(i) * (1 - Y(i)) * CB * e1_o(i)  )^2 + E3;
        bias3(i) = (1/adf) * ((LR * norm(e1_o(i))^2) * dk1_o(i) * CB + LD * e2_o(i) * CB);
    end
    dB3 = bias3;
    fprintf('layer hidden 1\n')
    % ========== Layer Hidden 2 ================================
    e1_h2 = zeros(1,JHneuron2);
    e2_h2 = e1_h2;
    for i = nh2_a:nh2_b
        dd = 0.5 * (1+Z2(i)) * (1-Z2(i));
        e1_h2(i) = dd * dk1_o * W3(i,:)';
        e2_h2(i) = dd * e2_o * W3(i,:)';
    end

    dW2 = zeros(JHneuron1,JHneuron2);
    delta2 = zeros(1,JHneuron2);
    for i = nh1_a:nh1_b
        for j = nh2_a:nh2_b
           adf = norm( 0.5 * (1+Z2(j)) * (1-Z2(j)) * Z1(i) * e1_h2(j)  )^2 + E3;
```

```
                delta2(j) = (1/adf) * ((LR * norm(e1_h2(j))^2) * Z1(i) * e1_h2(j) + LD * Z1(i) * e2_h2↙
(j));
            end
            dW2(i,:) = delta2;
        end

        bias2 = zeros(1,JHneuron2);
        for i = nh2_a:nh2_b
            adf = norm( 0.5 * (1+Z2(j)) * (1-Z2(j)) * CB * e1_h2(j)  )^2 + E3;
            bias2(i) = (1/adf) * ((LR * norm(e1_h2(j))^2) * e1_h2(i) * CB + LD * e2_h2(i) * CB);
        end
        dB2 = bias2;
        fprintf('hidden layer 2')
        % ========== Layer Hidden 1 ================================
        e1_h1 = zeros(1,JHneuron1);
        e2_h1 = e1_h1;
        for i = nh1_a:nh1_b
            dd = 0.5 * (1+Z1(i)) * (1-Z1(i));
            e1_h1(i) = dd * e1_h2 * W2(i,:)';
            e2_h1(i) = dd * e2_h2 * W2(i,:)';
        end

        dW1 = zeros(DimPola,JHneuron1);
        delta1 = zeros(1,JHneuron1);
        for i = 1:DimPola
            for j = nh1_a:nh1_b
               adf = norm( 0.5 * (1+Z1(j)) * (1-Z1(j)) * CP(i) * e1_h1(j)  )^2 + E3;
               delta1(j) = (1/adf) * ((LR * norm(e1_h1(j))^2) * CP(i) * e1_h1(j) + LD * CP(i) * e2_h1↙
(j));
            end
            dW1(i,:) = delta1;
        end

        bias1 = zeros(1,JHneuron1);
        for i = nh1_a:nh1_b
            adf = norm( 0.5 * (1+Z1(j)) * (1-Z1(j)) * CB * e1_h1(j)  )^2 + E3;
            bias1(i) = (1/adf) * ((LR * norm(e1_h1(j))^2) * e1_h1(i) * CB + LD * e2_h1(i) * CB);
        end
        dB1 = bias1;
        fprintf('perhitungan bobot dan bias\n')
        W1 = W1 + dW1;
        W2 = W2 + dW2;
        W3 = W3 + dW3;
        B1 = B1 + dB1;
        B2 = B2 + dB2;
        B3 = B3 + dB3;

    end % end for pp
    fprintf('perulangan baru\n')
    MSEepoch = (MSE_Linear/JumPola);
    %disp(['Epoch = ', num2str(ee), ' => Neighborhood-', num2str(ch_nei), ' MSE = ', num2str(MSEepoch)]);
    disp(['Epoch = ', num2str(ee), ' =>  MSE = ', num2str(MSEepoch)]);
    MSE(ee) = MSEepoch;
end % end while

toc;
if (MSE(ee) > MaxMSE)
    disp('Maximum epoch reached, performance goal was not met.');
else
    disp(['Performance goal met. Epoch = ', num2str(ee)]);
end

i=1:length( MSE(:,1:ee) );
j=1:0.1:length( MSE(:,1:ee) );
plot(i, MSE(:,1:ee), 'rs-',j,MaxMSE,'b-',i,-0.01);
xlabel([num2str(ee), ' Epochs']);
ylabel('Mean Squared Error (mse)');
title(['NMBP w/ Adaptive Learning, Perf is ', num2str(MSEepoch), ', Goal is ', num2str(MaxMSE)]);
legend('Training','Goal');
save TResult.mat CB W1 W2 W3 B1 B2 B3 JHneuron1 JHneuron2 JOneuron;

fileSave = ['Grafik _' datestr(now,'yyyymmdd-HHMM')];

save(fileSave);

%save gambar
saveas(gcf,fileSave,'png');

fprintf('simpan grafik sebagai: %s \n',fileSave);
```

Figure 11. Source Code of Training Backpropagation

```
% feedforward
      Z1 = zeros(1,JHneuron1);
      for i= 1:JHneuron1
          Z1(i) = tansig( CB * B1(:,i) + CP * W1(:,i) );
      end

      Z2 = zeros(1,JHneuron2);
      for i= 1:JHneuron2
          Z2(i) = tansig( CB * B2(:,i) + Z1 * W2(:,i) );
      end

      Y = zeros(1,JOneuron);
      Y_in = zeros(1,JOneuron);
      for i= 1:JOneuron
          Y_in(i) = CB * B3(:,i) + Z2 * W3(:,i);
          Y(i) = logsig( Y_in(i) );
      end

      if (Y < 0.5)
          if (nn > 4)
              %bb = ((0.999-0.001)-abs(0.999-Y))*100;
              %dd = dd + bb;
              %A1 = A1 + bb;
              K1 = K1 + 1 ;
              %disp(['*** File : ',ff,' => Microclasification Jinak salah dikenali, Validitas = ', num2str(bb), '%']);
               disp(['*** File : ',ff,' => Mikroklasifikasi Jinak salah dikenali ']);
          else
              cc = cc + 1;
              %bb = ((0.999-0.001)-abs(CT-Y))*100;
              %dd = dd + bb;
              %A2 = A2 + bb;
              J1 = J1 + 1;
              K1 = K1 + 1;
              %disp(['File : ',ff,' => Microclasification Jinak dikenali, Validitas = ', num2str(bb),'%']);
              disp(['*** File : ',ff,' => Mikroklasifikasi Jinak dikenali']);
          end

      elseif (Y > 0.5)
          if (nn <= 4)
              %bb = ((0.999-0.001)-abs(0.001-Y))*100;
              %dd = dd + bb;
              %A3 = A3 + bb;
              K2= K2 + 1;
              %disp(['*** File : ',ff,' => Microclasification Ganas salah dikenali, Validitas = ', num2str(bb), '%']);
              disp(['*** File : ',ff,' => Mikroklasifikasi Ganas salah dikenali ']);
          else
              cc = cc + 1;
              %bb = ((0.999-0.001)-abs(CT-Y))*100;
              %dd = dd + bb;
              %A4 = A4 + bb;
              J2 = J2 + 1;
              K2 = K2 + 1;
              %disp(['File : ',ff,' => Microclasification Ganas dikenali, Validitas = ', num2str(bb),'%']);
              disp(['*** File : ',ff,' => Mikroklasifikasi Ganas dikenali ']);

          end

      else
         %bb = ((0.999-0.001)-abs(CT-Y))*100;
         %dd = dd + bb;
         %A5 = A5 + bb;
         %disp(['*** File : ',ff,' => Microclasification salah dikenali, Validitas = ', num2str(bb), '%']);
         K3 = K3 + 1;
         disp(['*** File : ',ff,' => Mikroklasifikasi salah dikenali']);

      end
  end

  akurasiJinak = (J1*100)/4 ;
  akurasiGanas = (J2*100)/4 ;
  disp(' ');
```

```
  %disp(['Jumlah Pola Semua= ', num2str(Test_Number), ', Dikenali = ', num2str(cc), ', Validitas = ',↙
num2str( dd/Test_Number ),',Akurasi = ', num2str( (cc*100)/Test_Number ), '%']);
  %disp(['Jumlah Pola Microclasification Jinak = ', num2str(4), ', Dikenali Microclasifikasi Jinak = ',↙
num2str(J1)]);
  %disp(['Microclasification Jinak --> Validitas = ', num2str( A2/4 ), ', Akurasi = ', num2str( (J1*100)/4↙
), '%']);
  %disp(['Jumlah Pola Microclasification Ganas= ', num2str(4), ', Dikenali Microclasification Ganas = ',↙
num2str(J2)]);
  %disp(['Microclasification Ganas --> Validitas = ', num2str( A4/4 ), ', Akurasi = ', num2str( (J2*100)/4↙
),'%']);
  %disp(['Average = ', num2str( (((J1*100)/4)+((J2*100)/4))/2 ), '%']);

  disp(['Jumlah Pola Semua= ', num2str(Test_Number), ' => Mikroklasifikasi Jinak = ', num2str(K1), ',↙
Mikroklasifikasi Ganas = ', num2str(K2)]);
  disp(['Dikenali = ', num2str(cc), ' => Dikenali Mikroklasifikasi Jinak = ', num2str(J1), ', Dikenali↙
Mikroklasifikasi Ganas = ', num2str(J2)]);
  disp(['Jumlah Pola Mikroklasifikasi Jinak = ', num2str(4), ', Akurasi = ', num2str(akurasiJinak), '%']);
  disp(['Jumlah Pola Mikroklasifikasi Ganas = ', num2str(4), ', Akurasi = ', num2str(akurasiGanas),'%']);


%simpan variabel hasil
fileSave = ['hasil _' num2str(akurasiJinak) '_' num2str(akurasiGanas) '_' datestr(now,'yyyymmdd-HHMM')];

save(fileSave);

%save gambar
fprintf('simpan hasil sebagai: %s \n',fileSave);
```

Figure 12. Source Code of Testing Backpropagation

8. Activity Name : Data Analysis

   Name : Dr. Moh. Hafiyusholeh, M.Si

   Activity : Analyzing statistically the final final

   Activity Results : A system that performs classification is expected to be able to classify all data sets correctly, but the performance of a system can reach 100% correctly. Therefore, the measurement of breast cancer classification uses three performance gauges, namely accuracy, specificity sensitivity, and precision. The third performance of this equation each, namely:

$$accuracy = \frac{the\ amount\ of\ data\ that\ is\ classifiable\ correct}{amount\ of\ classification\ conducted}$$

$$sensitivity = \frac{TP}{TP + FN}$$

$$Specificity = \frac{TN}{FP + TN}$$

$$Precision = \frac{TP}{FP + TP}$$

Description:

TP = The sick are diagnosed correctly as sick

FP = Healthy people who are diagnosed wrongly as sick

TN = Healthy people who are diagnosed correctly as healthy

FN = People who are diagnosed wrongly as healthy

The results of this study

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KEPUTUSAN PEJABAT PEMBUAT KOMITMEN
DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM
KEMENTERIAN AGAMA
NOMOR 4842 TAHUN 2018

TENTANG
PERUBAHAN ATAS KEPUTUSAN PEJABAT PEMBUAT KOMITMEN
DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM KEMENTERIAN AGAMA
NOMOR 4670 TAHUN 2018 TENTANG PENETAPAN PENERIMA BANTUAN
PENINGKATAN MUTU PENELITIAN TERAPAN
TAHUN ANGGARAN 2018

DENGAN RAHMAT TUHAN YANG MAHA ESA,

PEJABAT PEMBUAT KOMITMEN
DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM
KEMENTERIAN AGAMA,

Menimbang :

a. bahwa dalam rangka meningkatkan mutu penelitian para dosen di lingkungan PTKI, dipandang perlu diberikan bantuan Peningkatan Mutu Penelitian Terapan Tahun Anggaran 2018;
b. bahwa nama-nama dosen sebagaimana tercantum dalam Lampiran Keputusan ini dipandang memenuhi syarat dan ketentuan untuk menerima bantuan dana Peningkatan Mutu Penelitian Terapan Tahun Anggaran 2018;
c. bahwa berdasarkan pertimbangan sebagaimana dimaksud dalam huruf a dan huruf b, perlu menetapkan Keputusan Pejabat Pembuat Komitmen Direktorat Pendidikan Tinggi Keagamaan Islam Direktorat Jenderal Pendidikan Islam Kementerian Agama tentang Perubahan Atas Keputusan Pejabat Pembuat Komitmen Direktorat Pendidikan Tinggi Keagamaan Islam Direktorat Jenderal Pendidikan Islam Kementerian Agama Nomor 4670 Tahun 2018 Tentang Penetapan Penerima Bantuan Peningkatan Mutu Penelitian Terapan Tahun Anggaran 2018;

Mengingat :

1. Undang-Undang Nomor 17 Tahun 2003 tentang Keuangan Negara (Lembaran Negara Republik Indonesia Tahun 2003 Nomor 47, Tambahan Lembaran Negara Republik Indonesia Nomor 4286);
2. Undang-Undang Nomor 14 Tahun 2005 tentang Guru dan Dosen (Lembaran Negara Republik Indonesia Tahun 2005 Nomor 157, Tambahan Lembaran Negara Republik Indonesia Nomor 4586);
3. Undang-Undang Nomor 12 Tahun 2012 tentang Pendidikan Tinggi (Lembaran Negara Republik Indonesia Tahun 2012 Nomor 158, Tambahan Lembaran Negara Republik Indonesia Nomor 5336);
4. Undang-Undang Nomor 15 Tahun 2017 tentang Anggaran Pendapatan dan Belanja Negara Tahun Anggaran 2018 (Lembaran Negara Republik Indonesia Tahun 2017 Nomor

233, Tambahan Lembaran Negara Republik Indonesia Nomor 6138);

5. Peraturan Pemerintah Nomor 37 Tahun 2009 tentang Dosen (Lembaran Negara Republik Indonesia Tahun 2009 Nomor 76, Tambahan Lembaran Negara Republik Indonesia Nomor 5007);
6. Peraturan Pemerintah Nomor 45 Tahun 2013 tentang Tata Cara Pelaksanaan Anggaran Pendapatan dan Belanja Negara (Lembaran Negara Republik Indonesia Tahun 2013 Nomor 103, Tambahan Lembaran Negara Republik Indonesia Nomor 5423);
7. Peraturan Presiden Nomor 83 Tahun 2015 tentang Kementerian Agama;
8. Peraturan Menteri Keuangan Nomor 190/PMK.05/2012 tentang Tata Cara Pelaksanaan Anggaran Pendapatan dan Belanja Negara;
9. Peraturan Menteri Agama Nomor 45 Tahun 2014 tentang Pejabat Perbendaharaan Negara Pada Kementerian Agama sebagaimana telah diubah dengan Peraturan Menteri Agama Nomor 63 Tahun 2016 tentang Perubahan Atas Peraturan Menteri Agama Nomor 45 Tahun 2014 tentang Pejabat Perbendaharaan Negara Pada Kementerian Agama;
10. Peraturan Menteri Agama Nomor 55 Tahun 2014 tentang Penelitian dan Pengabdian kepada Masyarakat;
11. Peraturan Menteri Keuangan Nomor 168/PMK.05/2015 tentang Mekanisme Pelaksanaan Anggaran Bantuan Pemerintah Pada Kementerian Negara/Lembaga sebagaimana telah diubah dengan Peraturan Menteri Keuangan Nomor 173/PMK.05/2016 tentang Perubahan Atas Peraturan Menteri Keuangan Nomor 168/PMK.05/2015 tentang Mekanisme Pelaksanaan Anggaran Bantuan Pemerintah Pada Kementerian Negara/Lembaga;
12. Peraturan Menteri Agama Nomor 67 Tahun 2015 tentang Bantuan Pemerintah pada Kementerian Agama sebagaimana telah beberapa kali diubah terakhir dengan Peraturan Menteri Agama Nomor 62 Tahun 2016 tentang Perubahan Kedua Atas Peraturan Menteri Agama Nomor 67 Tahun 2015 tentang Bantuan Pemerintah Pada Kementerian Agama;
13. Peraturan Menteri Agama Nomor 42 Tahun 2016 tentang Organisasi dan Tata Kerja Kementerian Agama;
14. Peraturan Menteri Keuangan Nomor 49/PMK.02/2017 tentang Standar Biaya Masukan Tahun Anggaran 2018;
15. Peraturan Menteri Keuangan Nomor 86/PMK.02/2017 tentang Standar Biaya Keluaran Tahun Anggaran 2018;

MEMUTUSKAN:

Menetapkan : KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM DIREKTORAT JENDERAL PENDIDIKAN ISLAM KEMENTERIAN AGAMA TENTANG PERUBAHAN ATAS KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM DIREKTORAT JENDERAL PENDIDIKAN ISLAM KEMENTERIAN AGAMA NOMOR 4670 TAHUN 2018 TENTANG PENETAPAN PENERIMA BANTUAN PENINGKATAN MUTU PENELITIAN TERAPAN TAHUN ANGGARAN 2018.

KESATU : Menetapkan nama-nama sebagaimana tercantum pada kolom 3 (tiga) dalam Lampiran Keputusan ini sebagai Penerima Dana Bantuan Peningkatan Mutu Penelitian Terapan Tahun Anggaran 2018, dengan jumlah sebagaimana tercantum pada kolom 6 (enam) dalam Lampiran Keputusan ini.

KEDUA : Mekanisme pencairan dan penggunaan bantuan:

1. Proses pencairan bantuan ini mengacu kepada peraturan perundang-undangan yang berlaku.
2. Penggunaan bantuan ini adalah untuk membantu para dosen dalam pelaksanaan peningkatan mutu penelitian pada PTKI.
3. Penggunaan bantuan ini dipertanggungjawabkan oleh penerima dana bantuan dan dilaporkan kepada Direktur Pendidikan Tinggi Keagamaan Islam.
4. Ketentuan-ketentuan lain berkenaan dengan pelaksanaan dan pelaporan mengacu kepada petunjuk teknis yang telah ditetapkan.

KETIGA : Pemberian bantuan sebagaimana dimaksud dalam Diktum KESATU dibebankan pada Daftar Isian Pelaksanaan Anggaran (DIPA) Direktorat Jenderal Pendidikan Islam Kementerian Agama Tahun Anggaran 2018 Nomor: 025.04.1.426302/2018, 2 Mei 2018 dengan Kode Mata Anggaran Nomor 025.04.07.2132.050.514.004.A.521219.

KEEMPAT : Keputusan ini mulai berlaku pada tanggal ditetapkan.

Ditetapkan di Jakarta
pada tanggal 3 September 2018

	PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM DIREKTORAT JENDERAL PENDIDIKAN ISLAM
Disahkan Oleh DIREKTUR JENDERAL,	
TTD,	TTD,
KAMARUDDIN AMIN	M. ARSKAL SALIM GP

LAMPIRAN I
KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM
NOMOR : 4842 TAHUN 2018 TANGGAL : 3 September 2018
TENTANG

PERUBAHAN ATAS KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM KEMENTERIAN AGAMA NOMOR 4670 TAHUN 2018 TENTANG
PENETAPAN PENERIMA BANTUAN PENINGKATAN MUTU PENELITIAN TERAPAN TAHUN ANGGARAN 2018

PENETAPAN PENERIMA BANTUAN KLASTER PENELITIAN UNGGULAN / COLABORATIVE RESEARCH
TAHUN ANGGARAN 2018

NO	NO REGISTRASI	NAMA PESERTA	JUDUL	INSTITUSI	BESARAN BANTUAN (RUPIAH)
1	171090000001755	Sukron Kamil Zakiya Darojat	Mosque, State, and Muslim Social Integration: A Comparative Study Of The Mosques In Indonesia, Spain, and Saudi Arabia	Universitas Islam Negeri Syarif Hidayatullah	Rp 200,000,000.00
2	171090000003658	Saifudin Zuhri Abdul Hadi Muhibbin	The Dinamics Of Islamic Law Contemporary Isues In Southeast Asia	Universitas Islam Negeri Walisongo Semarang	Rp 180,000,000.00
3	171090000001733	Muhamad Yahya Akhmad Sodiq Abd. Haris	Civil Enculturation Nation-State, School and Islamic Religiosity in Three Southeast Asian Countries	Universitas Islam Negeri Maulana Malik Ibrahim	Rp 180,000,000.00

4	171090000002892	Andi Faisal Bakti Zubair Hamka Hasan	Developing A Comprehensive Method In Countering Radical-Terrorism (A Study of Policies Applied in Indonesia, the United States, and European Countries in Countering ISIS's Movement and Influence)	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
5	171090000007624	Masykuri Abdillah Arif Zamhari	The Study Of Islam And The Muslim Society In Southeast Asia: Continuity And Change	Universitas Islam Negeri Syarif Hidayatullah	Rp	180,000,000.00
6	172090000005074	Muhammad Saleh Tajuddin Wahyuddin Halim Muhaemin Latif	Reproduction, Fragmentation and Expansion Of Local Islamic Movements In and From South Sulawesi In The Twentieth Century	Universitas Islam Negeri Alauddin	Rp	160,000,000.00
7	171090000007713	Sutrisno Amin Abdullah	Model Of Clinical Practice Professional For Master Of Teaching Program: Benchmark MGSE Australia	Universitas Islam Negeri Sunan Kalijaga	Rp	200,000,000.00
8	171090000007738	Maila Dinia Husni Rahiem	Encouraging Tolerance And Preventing The Radicalization Of Children: Casae Studies In Jakarta And London	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
9	171090000003708	Jajang Jahroni Tasman	Middle Class Muslim Businessmen: A Comparative Study between Indonesia, Malaysia, and the Netherlands	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
10	171090000005954	Sujadi Nurhadi Maharsi	Indonesian Muslim Communities In The Netherlands: Identity Formation, Islamic Education, and Social Integratiion, 1971-2017	Universitas Islam Negeri Sunan Kalijaga	Rp	200,000,000.00

11	181010000009417	Alfian Zarfina Yenti	Special Features Of Melayu Jambi's Quran Manuscript (compared with Quran manuscript found in the Netherland and Several Universities's Archieves in Netherland)	Universitas Islam Negeri Sultan Thaha Saifuddin Jambi	Rp	200,000,000.00
12	171090000004682	Azhar Arsyad Muhammad Yaumi	The Development Of Online Learning And Its Implementation In Islamic Higher Education In Indonesia	Universitas Islam Negeri Alauddin	Rp	180,000,000.00
13	171090000004055	Ilfi Nurdiana Muhammad Sulhan	Small Business Barrier To Growth (A Case Study Of Small Enterprises In Indonesia And Malaysia)	Universitas Islam Negeri Maulana Malik Ibrahim	Rp	180,000,000.00
14	171090000001817	Asep Saepudin Jahar Muhson Nawawi	Managing Social Capital In Developing Islamic Micro Finance Enterprises (BMT) In Muslim Countries: Case Study In Indonesia, Turkey, Bangladesh and Pakistan.	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
15	171090000001745	Aziz Fahrurrazi Ekawati R. Yani'ah Wardani	Trend Of Urban Sufism Movement In Indonesia, Turkey, And Pakistan (Study on Perceptions, Responds, and Impacts of Modern Sufism Movement in Urban Society)	Universitas Islam Negeri Syarif Hidayatullah	Rp	190,000,000.00
16	171090000001494	Alimin Syaifudin Zuhri	إشكاليات اللغة والشرع فى مذكرات الجنيد البونى: دراسة وتحقيق	Universitas Islam Negeri Syarif Hidayatullah	Rp	180,000,000.00

17	171090000007621	Imam Taufiq M. Mukhsin jamil	The Virtual Ulama': Civic Education and Religiousity In Indonesian Networked Society	Universitas Islam Negeri Walisongo Semarang	Rp	180,000,000.00
18	181010000009418	Fridayanti Witrin Gamayanti Abdul Mujib	Design of Cognitive Behavior Therapy Based on Islamic Value	Universitas Islam Negeri Sunan Gunung Jati	Rp	170,000,000.00
19	181010000009537	Dzuriyatun Toyibah EvaMushoffa Wiwi Siti Sajaroh	Indonesian Muslim Millennials in the Australian: Islamic Organizations and Multiculturalism among the Diaspora	Universitas Islam Negeri Syarif Hidayatullah	Rp	190,000,000.00
20	181010000009165	Muh. Syaifudin Abdullah Affandi	Ta'amul al-Masihiyyain Ma'a Al-Qur'anil Karim wa mada Ta'atstsurihim bihi 'ala at-Tasamuh Nahwa Al-Muslimin (Dirasah Midaniyyah Muqaranah Bain Al-Masihiyyin fi Mishr wa Tunis wa Indunisia)	FAI Univ. Wahid Hasyim Semarang (UWH), Jawa Tengah	Rp	200,000,000.00
21	181010000009337	M. Suparta Lilik Ummi Kaltsum	Tahfidz Al-Qur'an Learning Model In Indonesia, Egypt, Iran, And Turkey	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
22	181010000009566	Nasaruddin Umar Abd. Muid N. Rosita Tandos	Ya'muru Masajidallah": Opportunity And Challenge In Enhancing Masjid's Functions And Roles (A Comparative Study of Faith-Based Organization in Indonesia, the United States, and Netherlands)	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00

23	1810100000009527	Yunita Faela Nisa Laifa Annisa Hendarmin Fadhilah Suralaga	Detecting Radicalization: A Proposed Model of Radicalism among Indonesian Students in the Netherlands	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
24	1710800000001990	Armai Arief A Thib Raya Alek	Implementation of the strengthening of democracy In education to provide the undestanding of pluralism towards learners in america	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
25	1710900000005503	Agus Muhammad Najib Zaenudin	التسامح الدينى: (معالم تونسية بعد تطبيق القانون بجواز نكاح المرأة المسلمة بالمسيحي)	Universitas Islam Negeri Sunan Kalijaga	Rp	180,000,000.00
26	1710900000001868	Flori Ratna Sari Fika Ekayanti	The Efficacy Of Prophetic Cupping And Ruqya Treatment For Hypertensive Patients In South Tangerang, Indonesia: Medical and Historical Philology Perspectives	Universitas Islam Negeri Syarif Hidayatullah	Rp	180,000,000.00
27	1710900000004573	Agus Salim Nunung Isnaini Dwi Ningsih Nurmaya Arofah	Catchmen Dynamic Of Jakarta And Paris Urban Lakes	Universitas Islam Negeri Syarif Hidayatullah	Rp	200,000,000.00
28	1710900000001536	Bahrul Hayat Rena Latifa Diana Mutiah	The Psychological Dimensions of Religious Intolerance: A Study of Young Indonesian Moslems	Universitas Islam Negeri Syarif Hidayatullah	Rp	180,000,000.00
29	1710900000001730	Muhamad Said M. Arief Mufraini	Fundamentalism and Religious Market in the Modern Islamic Banking and Finance Development: Strategy and Profitability Level in Indonesia	Universitas Islam Negeri Syarif Hidayatullah	Rp	160,000,000.00

30	171090000004676	Mardan Arifuddin Siraj Muhammad Wayong	Gender Segregation In University Management: A Deskriptive Analitic Study at the State Islamic Universities of Indonesia and Helsinki University of Finlandia	Universitas Islam Negeri Alauddin	Rp 200,000,000.00
31	171090000001540	Kusmana, Norbani Binti Islmail	The Qur'an and Modernity: Competing Narratives on the Concept of an Ideal Family in Contemporary Islamic Discourse in Southeast Asia	Universitas Islam Negeri Syarif Hidayatullah	Rp 160,000,000.00
32	181010000010466	Luqyan Tamanni Yen Yen Ari Indrawijaya Wirda Anggraini	The Attainment of Maqasid Principles and Sustainable Development Goals (SDGs) from Islamic Microfinance Practices in South East Asia	Sekolah Tinggi Ekonomi Islam (STEI) Tazkia, Bogor	Rp 190,000,000.00
33	181010000009507	Riswan Efendi Nelsi Arisandy Susnaningsih	Decision Support Model for Categorical Data Analysis Using Rough-Regression and Its Implementations in Financial Wellbeing (Case Study: Academic Staff of State Islamic Universities in Indonesia and Malaysia	Universitas Islam Negeri Sulthan Syarif Kasim	Rp 170,000,000.00
34	171090000005591	Makhrus, Ahmad Bahiej, Riyanta	Chemical Castration for Sexual Offenders in Indonesia (A Study from Chemical Castration in South Korea and United States of America)	Universitas Islam Negeri Sunan Kalijaga	Rp 180,000,000.00
35	171090000004593	Alimatul Qibtiyah, Siti Ruhaini Dzuhaytain, Sawyer Martin French,Noorkamilah	Negotiating Modern Islamic Identity: The Revival of Cadari in Indonesia, Egypt and Denmark	Universitas Islam Negeri Sunan Kalijaga	Rp 180,000,000.00

36	171090000005735	Abdurachman Assegaf, Zulkipli Lessy, Evita Yuliatul Wahidah	Developing Model Of Learning Strategies For Disability Students At Higher Education Institution In Indonesia, India And South Korea: Policy Analysis and Curriculum Structures	Universitas Islam Negeri Sunan Kalijaga	Rp 170,000,000.00
37	181010000010347	Ahmad Zaki Mubarak Badrudin Dendi Yuda	Teacher's Readiness And Commitment To Implement Curriculum Change (Comparative Study between Indonesia and Australia Curriculum System	STAI Tasikmalaya	Rp 200,000,000.00
38	171090000003633	Bayyinatul Muchtaromah Mujahidin Ahmad Didik Wahyudi	Characterization Of Nanoparticles Of Allium Sativum, Curcuma Mangga And Acorus Calamus Coated Chitosan As A Basic Of Nanotechnology Development On Jamu Subur Kandungan Madura(The Implementation Of The Qur'an As-Syu'ara: 7-9)	Universitas Islam Negeri Maulana Malik Ibrahim	Rp 160,000,000.00
39	181010000009508	Sugiyarti Fatma Laela Murniati Mukhlisin	Participatory Action Research on Poverty Eradication Through Financial Discipline: Indonesia, Egypt and Pakistan	Sekolah Tinggi Ekonomi Islam (STEI) Tazkia, Bogor	Rp 170,000,000.00
JUMLAH					**Rp 7,250,000,000.00**

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LAMPIRAN II
KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM
NOMOR : 4842 TAHUN 2018 TANGGAL : 3 September 2018
TENTANG

PERUBAHAN ATAS KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM KEMENTERIAN AGAMA NOMOR 4670 TAHUN 2018 TENTANG
PENETAPAN PENERIMA BANTUAN PENINGKATAN MUTU PENELITIAN TERAPAN TAHUN ANGGARAN 2018

PENETAPAN PENERIMA BANTUAN KLASTER PENELITIAN TERAPAN DAN PENGEMBANGAN GLOBAL INTERNASIONAL TAHUN ANGGARAN 2018

NO	NO REGISTRASI	NAMA PESERTA	JUDUL	INSTITUSI	BESARAN BANTUAN (RUPIAH)
1	171080000007731	Badrus Sholeh, Mohammad Hasan Anshor, Rohan Gunaratna	Indonesian Regional Diplomacy on Rohingya Refugees	UIN Syarif Hidayatullah	Rp 110,000,000.00
2	181020000010241	Sahiron Samsuddin, Affandi Muchtar, Adib	Membangun Epistemologi Pesantren: Studi Atas Kajian Kepesantrenan Pada Perguruan Tinggi Islam	Universitas Islam Negeri Sunan Kalijaga	Rp 120,000,000.00
3	181020000009333	Jajang A Rohmana, Muhamad Zuldin	Colonial Informant and The Aceh War: The Letters of Haji Hasan Mustapa as a Penghulu of Kutaraja (Or. 18.079)	Universitas Islam Negeri Sunan Gunung Jati	Rp 80,000,000.00
4	171080000006769	Syamsul Maarif, Thohir Yuli Kusmanto, Sholihan, Leonard Sebastian	Contra-Radicalism Through Islamic Education In Indonesia And Singapore	UIN Walisongo Semarang	Rp 110,000,000.00

5	171080000006374	Didin Nuruddin Hidayat, Ting Wang	The Study of School Leadership Practice: An In-Depth Exploration in Indonesian Madrasah Aliyahs (Islamic-Based Senior High Schools)	Universitas Islam Negeri Syarif Hidayatullah	Rp	110,000,000.00
6	171080000003492	Arif Maftuhin Astri Hanjarwati	Aksesibilitas Ibadah Di Masjid Haram Dan Masjid Nabi: Menemukan Islam Inklusif Di Dua Masjid Mulia	UIN Sunan Kalijaga	Rp	115,000,000.00
7	171080000004724	Husein Aziz Sirajul Arifin Yasid	I'âdah Ta'zîz al-Tafkîr al-Usûlî wa al-Tatbîq al-Fiqhî: Tajribat al-Tahlîl al-Maqâsidî Tijâh al-Qadâyâ al-Fiqhîyah al-Nawâziliyah bi al-Jâmi'â h al-Islâmîyah al-Hukûmiyah Sunan Ambîl Sûrâbâyâ Indûnîsiyâ wa Mu'assasah Dâr al-Hadîth al-Hasanîyah al-Ribât al-Mamlakah al-Maghribîyah	UIN Sunan Ampel	Rp	110,000,000.00
8	171080000008894	Fahmyddin Araaf Tauhid, Eng. Ratriana Said, Christopher Silver	Pengembangan Dan Analisa Index Pengukuran Ketahanan Bencana Masyarakat: Studi Kasus Kota Jakarta Dengan Pendekatan Spatial Analysis	UIN Alauddin	Rp	100,000,000.00
9	171080000009321	Mayreyna Nurwardani, Lindra Darnela, Moh. Khoerul Anwar	Rancangbangun dan Penerapan Sistem Tracer Studi di Perguruan Tinggi keagamaan Islam	UIN Sunan Kalijaga	Rp	120,000,000.00
10	171080000005946	Kardimin, Na'imah, Jarot Wahyudi	Multicultural Education in Indonesian and Australian Families (A Case Study In Yogyakarta and Newcastle)	UIN Sunan Kalijaga	Rp	120,000,000.00

11	171080000001240	M. Yusuf, Sulaiman, Suci al Munawarah	Kompetensi Akademik Dosen Dan Implikasinya Terhadap Kualitas Perkuliahan (Suatu Kajian Tentang Climate Belajar Mahasiswa Pada Fakultas Pendidikan Universitas Utara Malaysia Dan Fakultas Tarbiyah UIN Ar-Raniry Banda Aceh)	UIN Ar-Raniry Banda Aceh	Rp	110,000,000.00
12	171080000002093	Utang Ranuwijaya Erdi Rujikartawi Iin Ratna Sumirat Wazin	Ekowisata Kawasan Ekonomi Khusus (Kek) Tanjung Lesung Banten Membangun Masyarakat Berdaya Ekonomi, Sosial Dan Ekologi Syariah	UIN Sultan Maulana Hasanuddin Banten	Rp	100,000,000.00
13	171080000009030	Shiyamu Manurung Purbatua Manurung	Penguatan Pendidikan Karakter dalam Keluarga Batak Toba di Kabupaten Samosir	UIN Sumatera Utara Medan	Rp	105,000,000.00
14	171080000007138	Qomarul Huda Achmad Tjachja Nugraha	The Individual Perceptions In Adoption Of Halal Certification System: A Case Of The Indonesia Halal Industry	Universitas Islam Negeri Syarif Hidayatullah	Rp	100,000,000.00
15	171080000002670	Aninditya Sri Nugraheni Rohinah Indra Fajar Nurdin	The Analysis Of Current Policy Of The Implementation Of Indonesian Language Teaching At Australian Primary And Secondary Schools	UIN Sunan Kalijaga	Rp	120,000,000.00
16	171080000003578	Khoirul Hidayah, Jundiani, Iffaty Nasyi'ah	Peran Perbankan Menghadapi Asean Economic Community Dalam Mendukung Kredit Pertanian Melalui Jaminan Resi Gudang (Studi Pada Bank Umum Kabupaten Malang)	UIN Maulana Malik Ibrahim	Rp	80,000,000.00
17	171080000001039	Chris Adhiyanto Yardi Nurlaely Mida Rachmawati	Biomedical And Nano-Biotechnological Applications Of Archaeosomes From Archaea Isolated From Indonesian Volcanoes	UIN Syarif Hidayatullah	Rp	110,000,000.00

18	171080000005800	Ahmad Lubab Dian Candra Rini Novitasari Asri Sawiji	"Sistem Diagnosa Kanker Payudara Otomatis Menggunakan Hidden Markov Model dan Modifikasi Backpropagation" (Riset Kolaborasi dengan Universiti Teknologi Malaysia)	UIN Sunan Ampel	Rp 110,000,000.00
19	171080000005213	Edi Erwan, Alwis Nazir, Evi Irawati, Deni Fitra	Utilization of Watermelon Rind to Overcome Heat Stress Problems in Native Chickens	UIN Sulthan Syarif Kasim	Rp 110,000,000.00
20	171080000000412	Kusmawati Hatta Fahmi Yunus	Trauma Dan Penanganannya Dalam Masyarakat Korban Konflik Bersenjata Di Asia (Studi Deskriptif Komparatif Terhadap Masyarakat Pattani Thailand, Moro Filipina dan Aceh Indonesia)	UIN Ar-Raniry Banda Aceh	Rp 110,000,000.00
21	171080000005656	Sururin, Jejen Jaenuddin, Edi Sanjaya, Christa Testerink, Helen Chatterjee	Ideological Path of Science and Islam Integration in the Context of University Management: Responding Toward Major Scientific Discoeries on (Such as Stem Cell technology, Clonning dan Quantum Entanglement) and the Future of the Islamization of Science in State islamic Universities in Indonesia	UIN Syarif Hidayatullah	Rp 110,000,000.00
22	181020000009319	Nurul Chojimah, Puspita Mayaratri, Mulia Ardi	Linguistic Realizations of Gender Equality Promotion by Female Ulama	IAIN Tulungagung	Rp 80,000,000.00

23	181020000009343	Awan Kostrad Diharto, Waluyo	The Role of Leadership Agility and Organization Commitment Towards the Organizational Readiness for Change in Vuca World In State Islamic Higher Institutions in Central Java	IAIN Surakarta	Rp	80,000,000.00
24	181020000011059	Mohammad Rofiqi, Nur Hidayah	BAHTSUL MASAIL SEBAGAI METODE PENDIDIKAN ISLAM MODERAT: Action Research Perumusan Desain Operasional Pendidikan Kader Universitas Nahdlatul Ulama Yogyakarta	UNU Yogyakarta	Rp	100,000,000.00
25	171080000003736	Retno Susilowati, Roihatul Mutiah, Tias Pramesti Griana	Pengembangan Produk Fitofarmaka Bawang Dayak (Eleuterine Palmifolia) Sebagai Aplikasi Surat Albaqoroh Ayat 61 Untuk Agen Kemopreventif Kanker (Formulasi Dan Evaluasi Sediaan, Efektivitas, Toksisitas Dan Uji klinik Fase-1)	UIN Maulana Malik Ibrahim	Rp	90,000,000.00
26	171080000005320	Yani Suryani, Ida Kinasih, Epa Paujiah	Potensi Lalat Hermetia Illucens Sebagai Sumber Protein Dan Enzim Bagi Bioindustri	UIN Sunan Gunung Jati	Rp	80,000,000.00
27	181020000009515	A'ang Subiyakto Nur Aeni Hidayah	Factors Influencing The Readiness and Success of The Ubiquitous Learning Implementation in The Islamic Higher Education Institution in Indonesia	Universitas Islam Negeri Syarif Hidayatullah	Rp	80,000,000.00
28	171080000003177	Sri Harini, Aisyah Nur Handryant, Abdussakir	Integrated Sustainability Assessment Index Of Surabaya City With Casbee	UIN Maulana Malik Ibrahim	Rp	80,000,000.00

29	171080000000562	Endah Wulandari Ayu Fitri Hapsari	Pengembangan Parameter Pemeriksaan Molekuler Pada Darah Dan Cairan Serebrospinal Dalam Diagnosis Stroke	UIN Syarif Hidayatullah	Rp 70,000,000.00
30	181020000010129	Qurrotul Aini, Eva Khudzaeva	Knowledge Management System of Indonesia's Halal Potential Tourism Distribution Using Spatial Clustering Analysis	Universitas Islam Negeri Syarif Hidayatullah	Rp 100,000,000.00
31	171080000002515	Susminingsih, Agus Fakhrina, Sultan Syarif Ali	The Role Of Culture Lead Development In Empowering The Small-Medium Enterprises (Smes) In Indonesia And Brunei Darussalam	IAIN Pekalongan	Rp 100,000,000.00
32	181020000009046	Ismail, Afriantoni	Internasionalisasi Perguruan Tinggi Keagamaan Islam Negeri (Studi Komparatif UIN Syarif Hidayatullah dan UIN Maulana Malik Ibrahim)	Universitas Islam Negeri Raden Fatah Palembang	Rp 70,000,000.00
33	171080000000933	Nur Aida, Chiba Satoshi	Numerical Analysis Of Neutrino Response To Electrochemical Apparatus In Wet And Radioactive Conditions	UIN Ar-Raniry Banda Aceh	Rp 70,000,000.00
34	171080000009199	Hendrawati, Fitriah Hatiningsih	Pengembangan Bioplastik Ramah Lingkungan Berbahan Dasar Pati Biji Nangka Dan Kulit Singkong, Kitosan Kulit Udang, Poli Vinil Alkohol, Gliserol Dan Selulosa Jerami Padi	UIN Syarif Hidayatullah	Rp 80,000,000.00
35	171080000004504	Dindin Jamaludin Tedi Priatna	Techno University Menjawab Tantangan Globalisasi: Studi Menuju UIN Sunan Gunung Djati Bandung Bereputasi Internasional	UIN Sunan Gunung Jati	Rp 70,000,000.00

36	171080000003568	Roibin Erik Sabti Rahmawati	Meminimalisasi Perilaku Kekerasan Beragama Perspektif Kearifan Lokal (Studi Atas Model Dialog Akulturatif antara Teologi, Kearifan lokal, dan Kekuasaan di Kalangan Masyarakat Muslim Fundamentalis di Jawa Timur)	UIN Maulana Malik Ibrahim	Rp 90,000,000.00
37	181020000009090	Muhammad Jafar Anwar	Rekonsiliasi Konfliks Bima Berbasis Kearifan Lokal (Kajian Kualitatif Dengan Snow Bolling Teachnique)	STAI Al-Aqidah Al-Hasyimiyah Jakarta, Jakarta Timur	Rp 70,000,000.00
38	171080000003437	Usman, Muhammad Mukhtar	Strategi Pengembangan Perguruan Tinggi Agama Islam Di Indonesia Dan Malaysia Menuju Perguruan Tinggi Kelas Dunia (Studi Komparasi Antara UIN Sunan Kalijaga Yogyakarta Dengan IIUM Malaysia)	UIN Sunan Kalijaga	Rp 90,000,000.00
39	171080000004798	Sangkot Sirait Muqowim Mahmud Arif	Charity Independent Education Between Democracy And Paternalism: An Empowerment Approach Study In Yogyakarta And New South Wales Australia	UIN Sunan Kalijaga	Rp 120,000,000.00
40	171080000001450	Kholis Ridho, Bintan Humaera, Helmi Hidayat, Sururoh Tullah Uthman	Survei Media, Islam dan Kebudayaan: Studi Konten Tayangan Televisi dan Media Sosial, serta Dampaknya Terhadap Perilaku Beragama dan Berbudaya Pada Masyarakat Muslim Negara Serumpun Indonesia, Malaysia dan Brunai Darussalam	UIN Syarif Hidayatullah	Rp 90,000,000.00
41	171080000000857	Ratna Sari Dewi, Desi Nahartini, Shirley Ann Baker, Hoang Quy	Best Practices for English Pre-Service Teachers Curriculum: Comparing Two ASEAN Countries	UIN Syarif Hidayatullah	Rp 90,000,000.00

42	181020000009164	Giyoto, Toto Suharto, Ika Sulistyarini	Pengembangan Model Pembentukan Kompetensi Kepribadian bagi Peserta PPG PTKIN Se-Jawa Tengah	IAIN Surakarta	Rp 90,000,000.00
43	181020000010368	Ahmad Hasan Ridwan, Ikhwan Aulia Fatahillah, Muhammad Hasanuddin, Ine Fauzia	The Halal Concept and its Implication upon Green Industry in Halal Implementing Countries (Malaysia and Singapore)	Universitas Islam Negeri Sunan Gunung Jati	Rp 110,000,000.00
44	171080000001654	Nurmawati, Zulfikri, Mauloeddin Afna, Khairul Amri, Syahyar Rhidama Putra	The Cross-Sectional Islamic Educational Fostering To Rejuvenate Identity Among Malay Traditional Community For The South East Asia	IAIN Langsa	Rp 100,000,000.00
45	171080000001588	Nur Inayah, Rizal Bahawere, Subarja Yanne Irene Madona Yunita Wijaya	Development Of Electricity Monitors And Its Implementation For Energy Saving Potential In Public Buildings	UIN Syarif Hidayatullah	Rp 100,000,000.00
46	171080000008114	Abd. Khalik Latuconsina, Marcus Tukan, Yance Zadrak Rumahuru	Peran Transportasi Dan Pengaruhnya Terhadap Penyiaran Islam: Studi terhadap Masyarakat Muslim Maritim di Maluku	IAIN Ambon	Rp 80,000,000.00
JUMLAH					**Rp 4,440,000,000.00**

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LAMPIRAN III
KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM
NOMOR : 4842 TAHUN 2018 TANGGAL : 3 September 2018
TENTANG

PERUBAHAN ATAS KEPUTUSAN PEJABAT PEMBUAT KOMITMEN DIREKTORAT PENDIDIKAN TINGGI KEAGAMAAN ISLAM
DIREKTORAT JENDERAL PENDIDIKAN ISLAM KEMENTERIAN AGAMA NOMOR 4670 TAHUN 2018 TENTANG
PENETAPAN PENERIMA BANTUAN PENINGKATAN MUTU PENELITIAN TERAPAN TAHUN ANGGARAN 2018

PENETAPAN PENERIMA BANTUAN KLASTER PENELITIAN TRANSFORMATIF PENGABDIAN BERBASIS RISET (BPMPT-PTBR) TAHUN ANGGARAN 2018

NO	NO REGISTRASI	NAMA PESERTA	JUDUL	INSTITUSI	BESARAN BANTUAN (RUPIAH)
1	173010000003498	Istiadah Muhammad Edy Thoyib Syafiyah	Pengembangan Potensi Pariwisata Berwawasan Kearifan Lokal Guna Meningkatkan Daya Saing Destinasi Wisata Berbasis Budaya Di Kabupaten Malang	UIN Maulana Malik Ibrahim	Rp 75,000,000.00
2	173010000001193	Andi Susilawaty Nurdiyanah S. Syahrul Basri Emmi Bujawati	Penguatan Kapasitas Adaptasi terhadap Risiko Kesehatan Masyarakat Pulau Sembilan Berbasis Aset Lokal	UIN Alauddin	Rp 75,000,000.00
3	173010000001167	Esa Nur Wahyuni Alfiana Yuli Efiyanti Wildana Wargadinata	Membangun Sikap Optimis Remaja Yatim/Piatu Malalui Pelatihan Wirausaha Handycraft Di Dusun Sendang Biru Kecamatan Sumber Manjing Kabupaten Malang	UIN Maulana Malik Ibrahim	Rp 75,000,000.00

4	173010000004691	Muhammad Ardiansyah Moh. Salman Hamdani	Analisis Partisipatif Terhadap Sistem Kepemilikan Tanah dan Proses Pemiskinan di Desa Rowosari Jember melalui Sistem Pemetaan Geospasial dan Sosial	IAIN Jember	Rp	75,000,000.00
5	173010000002972	Ab. Musyafa' Fathoni Kadi Ahmad Nu'man Hakiem	Pengembangan Manajemen Sistem Informasi Pondok Pesantren Lirboyo Berbasis Teknologi Informasi	IAIN Ponorogo	Rp	75,000,000.00
6	181030000009152	Muhammad Obie Asna Usman Dilo	Pemberdayaan Rumah Tangga Miskin Melalui Pembuatan Kerajinan Sabut Kelapa (Studi Kasus di Kecamatan Bongomeme, Kabupaten Gorontalo)	IAIN Sultan Amai Gorontalo	Rp	75,000,000.00
7	181030000009385	Vaesol Wahyu Eka Irawan Agus Sultoni	"Kembali ke Jalan Damai" (Peran Mantan Kombatan dalam Proses Disengagedment Terorisme di yayasan Lingkar Perdamaian)	Sekolah Tinggi Islam Blambangan Banyuwangi	Rp	75,000,000.00
8	181030000009323	Kartini Jabal Nur	Peningkatan Kapasitas Kelembagaan bagi Remaja Rentan Kawin Campur di Wolasi Sulawesi Tenggara Melalui Pendekatan Dakwah Berbasis Konseling Hukum	IAIN Kendari	Rp	75,000,000.00
9	173010000003742	Agus Sucipto Sri Andriani	Pemberdayaan Komunitas, Budaya dan Usaha Kecil Menengah Melalui Program Indonesia Mandiri Dalam Rangka Terwujudnya Revolusi Mental di Desa Toyomarto Kecamatan Singosari Kabupaten Malang	UIN Maulana Malik Ibrahim	Rp	75,000,000.00

10	173010000001646	Ruhamah Nazaruddin	Pembuatan Pupuk Organik Untuk Meningkatkan Perekonomian Keluarga Berbasis Komunitas Di Kecamatan Arongan Lambalek Kabupaten Aceh Barat	UIN Ar-Raniry Banda Aceh	Rp	75,000,000.00
11	173010000003228	Zulfah Sulvinayajanti Rahmawati Usman	Peningkatan Keterampilan Mendesain Materi Ajar Audio Visual English Listening Skill Melalui Pemanfaatan Teknologi Informasi Bagi Guru Bahasa Inggris Madrasah Tsanawiyah di Kota Parepare	IAIN Parepare	Rp	75,000,000.00
12	181030000009279	Hakis Roswati Nurdin St. Syahruni Usman	Pendampingan Santri pada Pondok Pesantren Nurul Tsakalain Hila Berbasis Direct Intruktion Tentang Pencegahan Radikalisme di Maluku Tengah	IAIN Ambon	Rp	75,000,000.00
13	181030000009697	Nasaruddin Sri Dewi Lisnawaty	Strategi Bersaing Pedagang di Pasar Inpres Manonda Kota Palu (Perspektif Etika Bisnis Islam)	UIN Palu	Rp	75,000,000.00
14	173010000004441	Anggun Zuhaida Wulan Izzatul Himmah	Integrated Science Programe: Implementasi Integrasi Keilmuan dalam Pembelajaran Sains pada Madrasah Tsanawiyah (MTs) se-Kota Salatiga	IAIN Salatiga	Rp	75,000,000.00
15	181030000009231	Anna Zakiyah Hastriana Ubaidullah Muayyad	Bank Sampah Berbasis Syariah: Sebuah Model Penanganan Lingkungan Dalam Upaya Peningkatan Ekonomi Masyarakat Desa Pasongsongan	Institut Ilmu KeIslaman Annuqayah (INSTIKA) Guluk-Guluk Sumenep	Rp	75,000,000.00

16	181030000009502	Fadhilah Syafwar Irman Murisal	Penguatan Nilai Nilai Spritual Dan Budaya Melalui Konseling Islam Berbasis Babaliak Ka Surau Dalam Rangka Menuju Wisata Halal Di Nagari Pariangan Terindah Di Dunia Sumatera Barat	IAIN Batusangkar	Rp	75,000,000.00
17	173010000007432	Muhammad Hasbi M. Jhoni	Pendampingan Pembuatan Weblog, Media Pembelajaran dan RPP Inovatif guna Meningkatan Mutu Pembelajaran bagi Guru-guru Madrasah Darul Muttaqien	UIN Raden Fatah	Rp	75,000,000.00
18	181030000009077	Mukhibat Fata Asyrofi Yahya	Sedekah Sampah Sebagai Literasi Keuangan Pada Kelompok Kerja Raudhatul Athfal (Pokja Ra) Poncol Magetan	IAIN Ponorogo	Rp	75,000,000.00
19	181030000009338	Asep Jihad Wati Susilawati Ridha Abdullah	Pengembangan Model Daya Saing Global Madrasah Ibtidiyah (Mi) (Research and Development di MI Negeri dan Swasta di Jawa Barat)	UIN Sunan Gunung Jati	Rp	75,000,000.00
20	173010000001251	Muhammad Walid Luthfiya Fathi Pusposari Nurlaeli Fitriah	Penguatan Kultur Literasi Sekolah Rintisan Berbasis Riset Pada Madrasah Tsanawiyah Negeri I Batu Melalui Optimalisasi Fungsi Perpustakaan	UIN Maulana Malik Ibrahim	Rp	75,000,000.00
21	173010000005453	Ali Mudlofir Husniatus Salamah Siti Lailiyah Hernik Ferisia	Pemberdayaan Dan Peran Masyarakat Dalam Penumbuhan Budaya Baca Melalui Penerapan Kurikulum Wajib Baca Pada Madrasah Ibtidaiyah Di Surabaya	UIN Sunan Ampel	Rp	75,000,000.00

22	181030000010358	Husna Amal Wildan Hefni	Membendung Arus Kebangkitan Populisme Islamis Di Indonesia: Muslim Moderat, Counter Culture, Dan Demokratisasi	IAIN Jember	Rp	75,000,000.00
23	181030000009877	Dewi Ananda Mucra Triani Adelina	Optimalisasi Potensi Ampas Sagu Untuk Memperkuat Dan Memperluas Usaha Ekonomi Berbasis Teknologi Peternakan Sebagai Dasar Penanggulangan Kemiskinan Kelompok Tani Di Pulau Terluar Provinsi Riau	UIN Sulthan Syarif Kasim	Rp	75,000,000.00
24	181030000009299	Sutarto Ifnaldi	Konseling Eklektik Islami Bernuansa Kearifan Lokal Untuk Mengubah Konsep Diri Waria Di Desa Ujung Tanjung Kecamatan Lebong Sakti Kabupaten Lebong Provinsi Bengkulu	IAIN Curup	Rp	75,000,000.00
25	181030000009638	Heny Gustini Nuraeni	pemberdayaan usaha mandiri untuk meningkatkan kesejahteraan mantan pengemis di kampung pengengis sukajadi kota bandung	UIN Sunan Gunung Jati	Rp	75,000,000.00
26	181030000009535	Dindin Sobiruddin Dedek Kustiawati	Peningkatan Profesionalisme Guru Ra Melalui Pemanfaatan Media Ict Berbasis Proyektor Interaktif Di Daerah Pandeglang-Banten	UIN Syarif Hidayatullah	Rp	75,000,000.00
27	173010000001925	Nidaul Hasanati	Internet Marketing Untuk Peningkatan Daya Saing Pada Usaha Kecil Menengah (Ukm) Di Kota Tangerang Selatan	UIN Syarif Hidayatullah	Rp	75,000,000.00
28	181030000010183	Saifudin Asrori	Deradikalisasi Teroris; Penguatan Keterlibatan Mantan Napi Teroris (Napiter) Jaringan Lamongan	UIN Syarif Hidayatullah	Rp	75,000,000.00

29	181030000010395	Andi Novita Mudriani Djaoe	Pemberdayaan Perempuan Pesisir Talaga Raya Melalui Program Life Skill Development di Kepulauan Talaga Buton Tengah Sulawesi Tenggara	IAIN Kendari	Rp	75,000,000.00
30	181030000010284	Jasafat Hendri Ahmadian	Penguatan Pemasaran Industri Usaha Kecil Menengah (Ukm) Lokal Aceh Dengan Menggunakan Teknologi Informasi Dalam Upaya Pengembangan Ekonomi Kreatif Umat Muslim Di Era Digital	UIN Ar-Raniry Banda Aceh	Rp	75,000,000.00
31	181030000010236	Adinda Tessa Naumi Eka Apriani Bakti Komalasari Arsil	Pengalaman Antarbudaya dan Pendampingan Masyarakat Muslim Di Desa Suro Bali Kabupaten Kepahiang Provinsi Bengkulu (Studi Interaksi Sosial-Agama Islam dan Hindu)	IAIN Curup	Rp	75,000,000.00
32	181030000010549	Abdul Ghoni Kurnia Muhajarah	Pemberdayaan Ekonomi Ibu Rumah Tangga Berbasis Masjid Di Desa Leban Kecamatan Boja Kabupaten Kendal	UIN Walisongo Semarang	Rp	75,000,000.00
33	181030000010427	Sutaman Dien Nur Chotimah	Membangun Relasi Multikultural Berbasis Pesantren Di Desa Dodol, Kasembon, Kabupaten Malang	UIN Maulana Malik Ibrahim	Rp	75,000,000.00
34	181030000010222	Alimul Muniroh Moh. Nasrul Amin	PEREMPUAN DAN SEKOLAH LAPANG HASIL LAUT: Pemberdayaan Keluarga Buruh Migran Menuju Kemandirian Ekonomi di Dusun Druju Pangkah Kulon Gresik	Institut Agama Islam Tarbiyatut Tholabah Lamongan Jawa Timur	Rp	75,000,000.00

35	181030000010104	Iman Subasman Faat Nasyiruddin	TRANSFORMASI NAPI MENJADI SANTRI :(Analisis Implementasi Transtheoritical Model Di Pesantren At Tawwabin Pada Lembaga Pemasyarakatan Kelas II A Kuningan Jawa Barat)	Universitas Islam Al-Ihya Kuningan	Rp	75,000,000.00
36	181030000010500	Arya Wirabhuana Trio Yonathan Teja Kusuma Taufiq Aji	Peningkatan Kualitas Air Bersih Konsumsi Rumah Tangga Bagi Warga Yang Terdampak Limbah Dan Tinggal Di Lingkungan Dengan Kondisi Air Buruk Melalui Perancangan Alat Pemurnian Air Dengan Pendekatan Teknologi Tepat Guna	UIN Sunan Kalijaga	Rp	75,000,000.00
37	181030000010215	Megga Ratnasari Pikoli Suhendra Baihaki Ulma Nurkholida	Aplikasi Formula Inokulan Baru Untuk Pembentukan Gubal Tanaman Gaharu Di Cijeruk, Bogor, Yang Tergabung Dalam Komunitas Petani Gaharu Tanaman Rakyat Indonesia (Pegatri) Cabang Jawa Barat – Banten	UIN Syarif Hidayatullah	Rp	75,000,000.00
38	181030000010467	Lestari Handayani Dewi Diniaty Megawati	Pemberdayaan Masyarakat Melalui Pengolahan Sampah Secara Kreatif Berbasis Tekno Ekonomi Dengan Pelatihan Multimedia Di Kecamatan Marpoyan Damai Kota Pekanbaru	UIN Sulthan Syarif Kasim	Rp	75,000,000.00
39	181030000010415	Eka Srimulyani Miftahul Jannah Fatmawati	Dinamika Family Well Being Dan Pendampingan Psikologis Pada Perempuan Korban Pelecehan Dan Kekerasan Seksual Di Aceh	UIN Ar-Raniry Banda Aceh	Rp	75,000,000.00
40	181030000010431	Muhyar Fanani Endang Supriadi	Fikih Pemberdayaan Kaum Tani: Sebuah Kajian Transformatif	UIN Walisongo Semarang	Rp	75,000,000.00

41	181030000009973	Wahyudin Dharma Setyawan	Cadar Perempuan Salafi: Potret Konstruksi Sosial Dan Interaksi Di Perguruan Tinggi Iain Metro Dan Universitas Muhammadiyah Metro Lampung	IAIN Metro	Rp	75,000,000.00
42	181030000009660	Muhammad Qobidl'Ainul Arif	Respon Media Massa Negara Adidaya Terhadap Gelombang Populisme Religius Di Indonesia	UIN Sunan Ampel	Rp	75,000,000.00
43	181030000009053	Ahmad Zarnuji Hanif Amrulloh Isnaini Nur Azizah	Pemanfaatan Sekam Padi Menjadi Kertas Sebagai Media Kaligrafi Dalam Upaya Pemberdayaan Seniman Kaligrafi Di Kota Metro	Institut Agama Islam Ma'arif NU (IAIMNU) Metro Lampung	Rp	75,000,000.00
44	181030000009717	Hepi Riza Zen Bunyana Sholihin Iskandar syukur	Pemberdayaan Masyarakat Tani Way Ngison Tahun Ketiga (Pendampingan Pembentukan Kelompok Tani Dan Swasembada Listrik Tenaga Air)	UIN Raden Intan Lampung	Rp	75,000,000.00
45	173010000001092	Muhdar HM Sudirman	Peran Pelatihan Dalam Pengembangan Umkm Ternak Sapi Potong Sebagai Sektor Penggerak Ekonomi Desa Di Kabupaten Gorontalo	IAIN Sultan Amai Gorontalo	Rp	75,000,000.00
46	181030000009081	Muhammad Abdul Karim Riswinarno	Penguatan Dakwah Dan Wawasan Kebangsaan Dalam Membina Paham Radikal Dan Pemakai Cadar Di Uin Suna Kalijaga Yogyakarta	Universitas Islam Negeri Sunan Kalijaga	Rp	75,000,000.00
47	181030000009334	Khuriyah Siti Choiriyah	Pemetaan Kurikulum Di Sekolah Islam Terpadu (Analisis Potensi Radikalisme Pada Kurikulum Sekolah Islam Terpadu Di Wilayah Sukoharjo Jawa Tengah)	IAIN Surakarta	Rp	75,000,000.00

48	173010000001166	Muhammad Mahpur Rika Fu'atrosyid Muh Anwar Fu'ady Zainal Habib	Internalisasi Nilai-Nilai Revolusi Mental Pada Guru Pra-Sekolah Melalui Komunitas Guru Di Malang	UIN Maulana Malik Ibrahim	Rp	75,000,000.00
49	173010000008247	Mokhamad Irfan Robbana Saragih	Sekolah Lapang Sistem Pertanian Organik di Sentra Pertanian Sayur Jl. Kartama Kec. Marpoyan Damai Kota Pekanbaru	UIN Sulthan Syarif Kasim	Rp	75,000,000.00
50	181030000009154	Nur Hidayah Agus Salim Chamidi	Penguatan Bagi Anak Dengan Hiv Aids (Adha) Melalui Pengorganisasian Dan Advokasi	Institut Agama Islam Nahdlatul Ulama (IAI NU) Kebumen	Rp	75,000,000.00
51	173010000006039	Lilis Satriah Yuliani	Diseminasi model bimbingan kelompok untuk meningkatkan parenting skill orang tua dalam membangun karakter anak	UIN Sunan Gunung Djati	Rp	75,000,000.00
52	173010000004277	Kifayah Amar Siti Husna Ainu Syukri	Peningkatan Ekonomi Petani Di Kabupaten Kulonprogo Melalui Pengembangan Produk Makanan Berbahan Dasar Melon	UIN Sunan Kalijaga	Rp	75,000,000.00
53	181030000009040	Endang Rochmiatun Sri Suriana	Pemberdayaan Komunitas Budaya “Sedulang Setudung”di Desa Gelebeg Dalam Kabupaten Banyuasin Melalui Program Service Learning Pada Mata Kuliah “Islam Dan Budaya Lokal	UIN Raden Fatah Palembang	Rp	75,000,000.00

54	181030000009062	Akhmad Zaini Kautsar Wibawa	Penguatan Nilai-Nilai Budaya Lokal Berbasis Keluarga Di Kawasan Konflik Dan Ekowisata Bahari Kabupaten Situbondo Melalui Matakuliah Prodi Bimbingan Dan Penyuluhan Islam (Bpi)	Institut Agama Islam Ibrahimy (IAII) Sukorejo Situbondo	Rp	75,000,000.00
55	181030000009198	Supriatna Nurdhin Baroroh	Produksi Yogurt dan Es Krim Olahan Susu Sapi sebagai Peningkatan Ekonomi Peternak Sapi Berpenghasilan Rendah di Lereng Gunung Merapi	UIN Sunan Kalijaga	Rp	75,000,000.00
56	181030000009332	Ibi Satibi Mahmudah	Kontribusi Kongres Ulama Perempuan Indonesia (Kupi) Terhadap Penguatan Moderasi Islam Berperspektif Keadilan Gender Di Indonesia	UIN Sunan Kalijaga	Rp	75,000,000.00
57	173010000001118	Mahi Mamat Hikmat Yadi Mardiyansaah Yani Heryani Dadan Firdaus	Strategi-Strategi Pemberdayaan Masyarakat Sekitar Waduk Jatigede Kabupaten Sumedang	UIN Sunan Gunung Jati	Rp	75,000,000.00
58	181030000009461	Chaerul Rochman Aan Hasanah Dindin Nasrudin Endah Kurnia Yuningsih	Peningkatan Kompetensi Pedagogik Guru Madrasah Aliyah di Jawa Barat Melalui Pendekatan Integrasi Nilai Islam dan Sains	UIN Sunan Gunung Jati	Rp	75,000,000.00
59	181030000009086	Lukman Asyari Hasan	Analisis Komunitas Marginal Suku Kubu Dalam Upaya Pembinaan Agar Terlepas Dari Keterbelakangan Dan Kemiskinan (Studi Kasus Suku Anak Dalam di Kabuapeten Merangin Bangko Jambi)	UIN Syarif Hidayatullah	Rp	75,000,000.00

60	173010000003908	Atang Abd. Hakim Rohmanur Aziz Uu Nurul Huda	Pendampingan Tata Kelola Dana Desa Dan Pemberdayaan Kelompok Penggerak Pariwisata (Kompepar) dalam Mewujudkan Desa Wisata Halal di Desa Cibuntu, Kecamatan Pasawahan, Kabupaten Kuningan	UIN Sunan Gunung Jati	Rp	75,000,000.00
61	173010000001971	Musfiroh Nurlaili H. M.A. Ahmad Yani	Penguatan Literasi Dan Kesehatan Masyarakat Muslim Pedesaan Berbasis Sinergi Pondok Pesantren & Perguruan Tinggi (Tahap 2) (Kampung Tapos Karang Suraga Kec. Cinangka Kab.Serang Banten)	UIN Syarif Hidayatullah	Rp	75,000,000.00
62	181030000009184	Fadila Eka Yanuarti	Model Pendidikan Islam Terpadu Pada Anak Berhadapan Dengan Hukum (ABH) Melalui Audio Visual di Lapas Kelas II A Curup Kab Rejang Lebong	IAIN Curup	Rp	75,000,000.00
63	173010000004282	M Mudhofi Suprihatiningsih	Pemberdayaan Masyarakat Berbasis Komunitas Di Kelurahan Ngadirgo Kecamatan Mijen Semarang (Inovasi Laboratorium Outdoor Jurusan Pengembangan Masyarakat Islam)	UIN Walisongo Semarang	Rp	75,000,000.00
64	173010000004070	Inda Fitri Mega Orina Fitri Nurhayati Zain	Program Pendampingan Dan Pembinaan Peningkatan Kompetensi SDM Pepustakaan Madrasah/Sekolah Se-Propinsi Sumatera Barat	UIN Imam Bonjol Padang	Rp	75,000,000.00
65	181030000009156	Mada Sanjaya W. S. Astuti Kusumorini	Workshop Teknologi Robotik untuk Meningkatkan Life Skill Komunitas Robotik Sekolah di Cirebon dan Kabupaten Kuningan	UIN Sunan Gunung Jati	Rp	75,000,000.00

66	181030000009159	Ehwanudin Choirudin Mispani	Studi Pengembangan Perpustakaan Digital Sekolah NU (Pemberdayaan Beasiswa NU Smart sebagai Pendongkrak Literasi Digital)	Institut Agama Islam Ma'arif NU (IAIMNU) Metro Lampung	Rp	75,000,000.00
67	181030000009204	Asnaini Yosy Arisandy Yunida Een Fryanti	Pemberdayaan Keluarga Kampung Nelayan Sejahtera Pulau Baai Kota Bengkulu Menuju Masyarakat Mandiri Dan Religius	IAIN Bengkulu	Rp	75,000,000.00
68	181030000009070	Isji Hardi	Pengaruh Information Control Terhadap Kepuasan Pemustaka Pada Perpustakaan Pusat Iain Ternate	IAIN Ternate	Rp	75,000,000.00
69	181030000010344	Riri Fitria Aidil Novia	Pengembangan Keahlian Dan Keterampilan Para Da'i Kota Padang Melalui Pelatihan Takhrij Hadis Berbasis It	UIN Imam Bonjol Padang	Rp	75,000,000.00
70	181030000010337	Yosep Aspat Alamsyah Guntur Cahaya Kesuma	Pendampingan Ekonomi Melalui Program Pemeliharaan Kambing Pada Komunitas Marbot Dalam Upaya Kemandirian Ekonomi Di Metro Barat Kota Metro	UIN Raden Intan Lampung	Rp	75,000,000.00
71	181030000010163	Nurhayati Rayi Pradono Iswara	Pengembangan Algoritma Unsupervised Learning Technique pada Big Data Analisys di media sosial sebagai media promosi usaha online bagi masyarakat	UIN Syarif Hidayatullah	Rp	75,000,000.00
72	181030000010072	Ari Kristin Prasetyoningrum	Praktek Manajemen Laba Dalam Perbankan Syariah (Studi Empiris Pada Perbankan Syariah di Indonesia)	Universitas Islam Negeri Walisongo Semarang	Rp	75,000,000.00

73	181030000009917	Moh Yusup Saepuloh Jamal	Transformasi dan Optimalisasi Potensi Masjid Daerah Ujung Utara Kabupaten Tasikmalaya (Studi Kasus di Masjid Jami Al-Barokah Dusun Cikadu Guranteng Tasikmalaya)	Institut Agama Islam Latifah Mubarokiyah (IAILM) Suryalaya Tasikmalaya	Rp	75,000,000.00
74	181030000010055	Agus Retnanto Husni Mubarok	Evaluasi Kebijakan Peraturan Direktur Jenderal Pendidikan Islam Nomor 1429 Tahun 2012 Tentang Penataan Program Studi Di Perguruan Tinggi Keagamaan Islam Dan Pengaruhnya Bagi Program Studi Pendidikan Islam Di Lingkungan Iain Di Jawa Tengah	IAIN Kudus	Rp	75,000,000.00
75	173010000000126	Muhammad Ridwan Harahap Farid Fathony Ashal	Pelatihan Pengolahan Sampah Melalui Metode Insenerasi Dan Komposter Berbasis Pesantren Dengan Pendekatan Discovery Learning Di Pesantren Modern Al-Falah Abu Lam U Aceh Besar	UIN Ar-Raniry Banda Aceh	Rp	75,000,000.00
76	181030000010102	Muh. Baehaqi Eko Sariyekti	Peningkatan Kualitas Seni Rebana Dalam Komunitas Rebana Khairun-Nisa Di Kecamatan Tembarak Kabupaten Temanggung	STAI Nahdlatul Ulama (STAINU), Temanggung, Jawa Tengah	Rp	75,000,000.00
77	181030000009962	Shonhaji Muslim	Menyemai Budaya Damai Berbasis Pondok Pesantren Di Provinsi Rawan Konflik Lampung	UIN Raden Intan Lampung	Rp	75,000,000.00

78	181030000009170	Nur Alim Natsir Muhammad Rijal Idrus Sere	Pelatihan Dan Pendampingan Diversifikasi Produk Berbahan Dasar Tepung Ubi Jalar Ungu Bagi Kelompok Tani Di Desa Pulau Ay, Kecamatan Banda Naira Kabupaten Maluku Tengah	IAIN Ambon	Rp	75,000,000.00
79	173010000004903	Moh Muslih Aenurofik	Pengelolaan Lahan Kritis Untuk Peningkatan Ekonomi Masyarakat	IAIN Pekalongan	Rp	75,000,000.00
80	173010000003512	Nurul Arfinanti Sintha Sih Dewanti	Upaya Peningkatan Nilai Tambah Produk Bawang Merah (Tindak Lanjut KKN Di Desa Selopamioro, Imogiri, Bantul)	UIN Sunan Kalijaga	Rp	75,000,000.00
81	173010000003129	Iwan Setiawan Yadi Janwari Nurul Hasana	Pengembangan Ekonomi Syariah Pada Masyarakat Pesisir Pantai Selatan Propinsi Jawa Barat	UIN Sunan Gunung Jati	Rp	75,000,000.00
82	181030000010492	Rustan M. Thayyib Kaddase	Model Pembudayaan Dan Pemberdayaan Masyarakat Dalam Tata Kelola Sampah Melalui Penggunaan Media Tong Dan Kotak Terpadu	IAIN Palopo	Rp	75,000,000.00
83	181030000009979	Nadri Taja Dinar Nur Inten Arif Hakim	Meningkatkan Keterampilan Mengajar Baca Tulis Al-Qur`an Bagi Guru-Guru Madrasah Diniyyah Takmiliyyah Desa Lamajang Kecamatan Pangalengan Kabupaten Bandung Melalui Teknik MATA	FAI Univ. Islam Bandung (UNISBA) Bandung	Rp	75,000,000.00
84	173010000000094	Mujakir Rusydi	Desain Pembelajaran Kimia Inovatif pada Tingkat Madrasah Aliyah di Aceh	UIN Ar-Raniry Banda Aceh	Rp	75,000,000.00

85	173010000000334	Febrina Arfi	Pelatihan Dan Pembinaan Pengujian Pengawet Boraks Dalam Makanan Bagi Masyarakat Di Jalin Jhantou Aceh Besar Melalui Menggunan Bahan Dasar Kunyit	UIN Ar-Raniry Banda Aceh	Rp	75,000,000.00
86	173010000000408	Achmad Tubagus Surur Hasan Suaidi muhammad hufron	Edukasi Nasionalisme Masyarakat Pantura Jawa Tengah Dalam Rangka Penguatan Bela Negara Melalui Manajemen Majlis Ta'lim Thariqat Kanzus Shalawat Kota Pekalongan	IAIN Pekalongan	Rp	75,000,000.00
87	181030000009066	Titik Triwulan Titik	Perjanjian Perkawinan Atas Harta Bersama Dalam Perkawinan Campuran (Mixed Couple) Menurut Kuh Perdata Dan Undang-Undang Nomor 1 Tahun 1974 Pasca Putusan Mahkamah Konstitusi Nomor 69/Puu-Xiii/2015	UIN Sunan Ampel	Rp	75,000,000.00
88	181030000010771	Miftahul Ulum Mahbub Junaid Syaiful Anam	Mainstreaming Islam Moderat (Pendampingan Masyarakat Dalam Penguatan Moderasi Islam Di Satu Kelurahan Lima Agama: Kelurahan Bongkaran Kecamatan Pabean Cantian Kota Surabaya)	STAI Syaichona Moh. Cholil Bangkalan	Rp	75,000,000.00
89	181030000009694	Frenki Sofyan M Sholeh	Pemberdayaan Sekam Padi Menjadi Briket (Arang Sekam) Sebagai Alternatif Pilihan Pengganti Lpg	UIN Raden Intan Lampung	Rp	75,000,000.00
JUMLAH						**Rp6,675,000,000.00**

Disahkan oleh,
Direktur Jenderal Pendidikan Islam

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Pejabat Pembuat Komitmen
Direktorat Pendidikan Tinggi Keagamaan Islam
Direktorat Jenderal Pendidikan Islam

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M. ARSKAL SALIM GP