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Early Detection Of Alzheimer Disease In Elderly Web-Based Using Support Vector Machine Classification Method

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Abstract: Alzheimer's disease is characterized by dimentia diseases that usually begin with a decrease in memory. The number of people in around the world with dimentia diseases is estimated to reach 47.5 million and is increased to quadruple by 2050. The risk factors that make someone exposed Alzheimer's disease are aging, alcohol consumption, anterosclerosis, diabetes mellitus, down syndrome, genetics, hypertension, depression, and smoking. Aging is the biggest risk factor for Alzheimer's disease. People with age 65 years and over have a higher risk. Therefore, it is important to early detect Alzheimer's disease in order to start planning adequate care and medical needs. This study aims to create a web-based system for early detection of Alzheimer's disease in the elderly using support vector machine classification. Detection of Alzheimer's disease using the metric Mini Mental State Examination (MMSE) and Clinical Dementia Rating (CDR) obtained through questionnaires to find out about cognitive function, thinking ability and ability to perform daily tasks. Classification is carried out using the Support Vector Machine (SVM) algorithm. Alzheimer's classification testing uses a confusion matrix with an accuracy value of 85%. For system testing carried out User Acceptance Test with general practitioner, the results were obtained that all the features and functions of the system had run as expected.

Keywords: Alzheimer, Dimentia, MMSE, CDR, *Support vector machine*

1. Introduction

Alzheimer's disease is usually characterized by dementia that usually begin with a decrease in memory, a decrease in a ability to recognize something. That condition slowly becomes worse due to disturbances in the brain that are progressive or slow until finally the sufferer becomes unable to remember and recognize something [1]. This condition slowly becomes worse due to disorders in the brain either progressively or slowly until finally the sufferer becomes unable to remember and recognize something. Based on data from the World Health Organization (WHO) and alzheimer's disease international organization quoted through the website Ministry of Health of the Republic of Indonesia [2], the total number of people with dimensions in worldwide is estimated to reach 47.5 million and 22 million of them are in Asia. It is predicted to quadruple by 2050. According to Alzheimer's Disease International (ADI) data that quoted through the page CNN [3], the population of Indonesia that affected by dimentia is 1.2 million people and estimated to increase by 2 million by the following year and estimated increase by 4 million by 2050. The risk factors that make someone exposed Alzheimer's disease are aging, alcohol consumption, anterosclerosis, diabetes mellitus, down syndrome, genetics, hypertension, depression, and smoking. Aging is the biggest risk factor for Alzheimer's disease. People with age 65 years and over have a higher risk. The symptoms that experienced by Alzheimer patient in the early stages are memory disorders that are mild or senile in nature, such as forgetting the name of an object or place, and forgetting the events or content of conversations that had recently happened. As time goes by, the symptoms will get worse. In the later stages, Alzheimer patient will have difficulty speaking or explaining something, difficulty planning something, difficulty making decisions, will look confused, and experience personality changes [4].

Several studies have carried out early detection of Alzheimer's disease, which is : the creation of an expert system where users can find early symptoms of dementia, so that users can overcome the problem of the disease themselves without seeing a doctor or expert to help diagnose the disease [5]. The study used the Forward Chaining method, the programming language used is the Microsoft Visual Basic Studio 2008 and the database used is a MySQL. The results of this study are that with an expert system that be built, patients can get the

results of dimensional disease analysis; A literature study was conducted to analyze machine learning methods that used to help identify dimentia risks with neuroimaging [6]. The analysis was carried out by reviewing

papers from 2006 to 2016, namely machine learning methods used to distinguish healthy aging from various types of dimentia, assess the quality of studies, and compare accuracy at the limitations of different diseases. The data is analyzed by extracting different metrics from the paper or calculating them from the data provided. The study found that Machine learning with neuroimaging has not distinguished clinically the categories of disease; Detection of Alzheimer's disease using the Naïve Bayes classification method and the Correlation Based Feature Selection attribute selection method [7]. Data processing uses the Python programming language. The results obtained from this study are that the method used did not significantly increase the accuracy value, then this research has not been implemented into the form of a website, mobile, or desktop.

In the study, an early detection system for Alzheimer's disease on eldery was carried out in web-based and using Support Vector Machine (SVM) classification method. In this system, general practitioners fill out questionnaires related to cognitive function, thinking ability and the ability to perform daily tasks based on interviews with patients. The system will be able to generate a classification of data to find out whether the patient has alzheimer's or not. The programming language to be used is the Flaskweb-framework.

2. Methods

Creation of a web-based alzheimer's disease early detection system in elderly using the SVM classification algorithm apply the waterfall method. The stages in the Water Fall method are User Requirement, Design, Implementation and Testing. Modeling of SVM classification using machine learning stages, namely Data Collection, Data Preprocessing, Modeling, Evaluation. In the waterfall method, the User Requirement stage in this study is a literature study on Alzheimer's and early detection of Alzheimer's as well as a search for data sets regarding Alzheimer's. The Design Stage is machine learning modeling and web designing. The Implementation Stage is early detection web coding and incorporating machine learning models into web programming. The Testing Phase is web functionality testing using black box testing and machine learning testing, which is SVM classification testing using Confusion Matrix.

2.1 Early Detection of Alzheimer's in the Elderly

2.1.1 Alzheimer

Alzheimer's disease is usually characterized by dementia that usually begin with a decrease in memory, a decrease in a ability to recognize something. That condition slowly becomes worse due to disturbances in the brain that are progressive or slow until finally the sufferer becomes unable to remember and recognize something. The other signs are confusion, poor judgment, speech disorders, agitation, withdrawal, and hallucinations [1]. The exact cause of alzheimer's disease is not yet known. Some alternative causes that have been hypothesized are metal intoxidation, impaired immune function, viral infections, air / industrial pollution, trauma, neurotrasnmiter, deficit formation of filament cells, heriditer prediposition. The basis of the pathological abnormalities of Alzheimer's disease consists of neuronal degenarative, the death of specific regions of brain tissue resulting in impaired functioning with a progressive decrease in memory [4] . Alzheimer's disease has different stages of severity. This disease can start before the symptoms begin to appear until they cannot perform the activity as before. The stages of Alzheimer's disease include [8], [9]:

1. Stage 1: Symptoms not yet visible
   In this early stage people with Alzheimer's disease have not shown any symptoms or complaints. At this stage, the disease can only be detected if it is through further examinations such as Positron Emmision Tomography (PET) Scan.
2. Stage 2: A very mild decline in brain function
   At this stage, the sufferer begins to feel like he has forgotten about small things. But this very mild decline in brain function has not interfered with a person's life to do daily work.
3. Stage 3: A mild decline
   At this stage, changes begin to be seen in a person, for example, asking the same thing repeatedly.
4. Stage 4: Moderate decline
   At this stage, the changes that occurred in the previous stages are seen more clearly. Usually someone who suffers, at this stage they difficult to remember something that just happened.
5. Stage 5: Moderate-heavy decline
   At this stage an Alzheimer's sufferer begins to need someone to help him in carrying out daily activities. But sufferers can still remember and recognize their family members and still remember events in their past.

6. Stage 6: Heavy loss
   People with Alzheimer's at this stage need supervision from others. The symptoms that appear include often feeling dazed and confused. There is also the possibility of delusions in sufferers, for example, sufferers are getting ready to go to work even though they are no longer working.
7. Stage 7: Very heavy decline.
   People with Alzheimer's at this very severe stage will experience limitations in carrying out daily activities such as eating, walking, sitting, to difficulty in communicating with people around them. Sufferers at this stage can even lose the ability to swallow food.

To find out if a person has Alzheimer's disease or not, it can be done with a screening test [10]. The screening test is carried out in early anticipation to find out whether a person has potential cognitive problems or not. Some of the screening tests that can be done include the following:

1.Mini-Mental State Examination (MMSE)
2. Mini-Cog
3. Montreal Cognitive Assessment (MoCA)
4. Saint Louis University Mental Status Exam (SLUMS)
5. AD8 Informant Interview
6. The Clock-Drawing Test for Alzheimer's
7. The Brief Alzheimer's Screening Test
8. The 7 Minute Screen
9. The SAGE At-Home Test

2.1.2 Searching of Data For Early Detection of Alzheimer's Disease in The Elderly

The data search was carried out by conducting a survey at one of the hospitals in Pekanbaru. The result obtained is that the initial detection of Alzheimer's disease is a health check related to mental abilities. The examination of patients with Alzheimer's disease in that hospital, the patient must register in advance to get a patient card. Then the patient will be directed to enter the examination room of the neurologist. Inside the examination room, patients will undergo an interview test and undergo a Mini Mental State Examination (MMSE) test which is used to test mental abilities such as memory, attention, and language skills [11], [12].

In addition to conducting surveys, the exploratory of Alzheimer's dataset carried through. The dataset used for training. The Alzheimer dataset is from Kaggle, namely Alzheimer's Analysis conducted by Mitchel O'Brien in 2018. The data set has 14 attributes MRIID, SubjectID, Visit, MR Delay, CDR, Hand, Genre, Age, Educ, SES, MMSE, eTiv, nWBV, and ASP and 1 attribute as a label, namely Group. The label are demented and non demented. Demented means having Alzheimer's and Non Demented means not having Alzheimer's. After analyzing the data and based on the results of the previous survey, the dataset for SVM classification for the early detection system of Alzheimer's disease in the elderly uses the attributes Gender, Age, MMSE, CDR, and Group.

2.1.2.1 Mini-Mental State Examination (MMSE)

The MMSE value is obtained from the results of filling out the MMSE questionnaire. The MMSE is a questionnaire used to measure cognitive function, thinking ability, and ability to perform daily tasks. In Table 1, the following is a list of questions from the MMSE questionnaire form obtained from a neurologist at one of the hospitals in Pekanbaru[11].

Table 1 List of Question of MMSE Questionnaire

Question	Test	Maximal Value
Question 1	What (year) (season), (month), (date), (day) is it?	5
Question 2	In which (country), (province), (city), (hospital), (floor/room) are we ?	5
Question 3	Name 3 pieces of the name of the object (Apple, Table, Coin) [Every 1 second, the patient is told to repeat the three names of the objects. Give 1 for each correct item name. Repeat until the patient can mention correctly and record the number of repetitions]	3
Question 4	Subtract 100 by 7 [Give 1 for each correct answer. Stop after 5 answers] or to spell reversed the word	5

	'WAHYU' [the value is given to the correct letter before the error. e.g. uyahw = 2]	
Question 5	The patient is told to mention the names of the 3 objects above	3
Question 6	The patient is told to name the indicated object (pencil, book)	2
Question 7	The patient is told to repeat the words "however", "without", "when"	1
Question 8	The patient is told to do the command "take this paper with your hand, fold it in half and place it on the floor"	3
Question 9	The patient is told to read and perform the command "close your eyes"	1
Question 10	The patient is told to write spontaneously	1
Question 11	The patient is told to draw with a predetermined shape	1

2.1.2.2. Clinical Dementia Rating (CDR)

CDR to determine the level of dimentia clinically by diagnosing a disease while providing treatment for various physical, developmental, and behavioral disorders. CDR scores are obtained based on six different cognitive and behavioral domains such as memory, orientation, judgment and problem solving, outdoor activities, homework and hobbies, and personal care. To obtain six cognitive and behavioral domains in patients, interviews with patients and patient companions based on existing CDR questionnaires are required. The questionnaire used in this study was a questionnaire derived from Gelb and St.Laurent [13]. Table 2 are show some questions on the CDR questionnaire.

Table 2. List of Question of CDR Questionaire

Number	Question
1	Does he have a problem with his memory or thinking?
2	Can he remember the recent events?
3	Can he remember the short list of (shopping) items?
4	Are there some memories that deteriorated during the past?
5	Did his memory deteriorate in such a way that it would interfere with the activities of his daily life (or his pre-retirement activities)?
6	Did he really forget about major events (for example, trips, celebrations, family weddings) within a few weeks from the event?
7	Did he forget the details of the event that just happened?

2.1.3 Support Vector Machine (SVM) Classification Methods

Support Vector Machine (SVM) is one of the machine learning algorithms classified as a supervised learning method that works by finding the best hyperplane or separator function to separate two or more classes in the input space [14]. This algorithm creates a new class of data by grouping these data by separating them based on hyperplanes in N-dimensional space (N – number of features). Hyperplanes can be lines in two dimensions and can be flat planes in three dimensions. The mathematical function used in the transformation process of the SVM algorithm is a kernel function. Kernel functions are used to classify non-linear data. The trick is to convert non-linear data into linear data and then form a hyperplane. Linear kernel functions are recommended when linear separation of data is performed directly. In different cases, the use of other functions may be required. The SVM algorithm can be used for classification (SVM classification) and regression (SVM regression).

2.2 Designing Web Application Alzherimer Early Detection in Elderly with SVM Classification Method

Based on the results of the survey conducted previously, the proposed web application has a business process as follows the patient visits a health facility then the patient registers with the admin at the hospital or clinic, then the general practitioner conducts an interview with the patient or patient's companion according to the questionnaire contained in the system and the doctor fills in the interview results to the system. After

completing the interviews for MMSE and CDR, the doctor obtained the classification results whether the patient was classified as an Alzheimer's patient or not. The results of this system are early detection, so if the patient is classified as Alzheimer's then the patient must undergo further examination. Users in this system are hospital admins and general practitioners at a hospital or clinic. In the design of this web application, there is machine learning modeling, web system architecture, use cases and ERD.

2.2.1. Machine Learning modeling with SVM classification

2.2.1.1. Data Collection and Data Preprocessing

The data set used for the training data on the SVM model is data from Kaggle, namely the Alzheimer's Analysis conducted by Mitchel O'Brien in 2018 [15]. Dataset were 150 data, with 14 attributes which is MRIID, SubjectID, Visit, MR Delay, CDR, Hand, Genre, Age, Educ, SES, MMSE, eTiv, nWBV, and ASP and 1 attribute as a label, namely Group. There are two label which is Non Demented and Demented. After analyzing the data, data preprocessing is carried out by doing data cleaning of unnecessary attributes and deleting if there is empty data. So that the attributes that contained in the training data are Gender, Age, MMSE, CDR, and Group. Where Group is also a label attribute. And made adjustments to the label, being Alzheimer's and Not Alzheimer's. Table 3 shows some of the Alzheimer's training data.

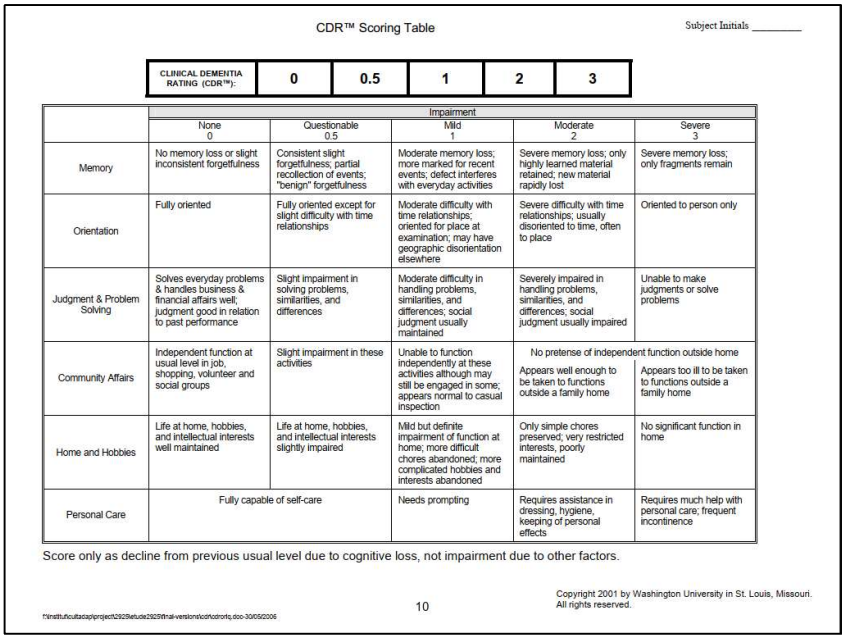
Table 3 The example of data training Machine Learning at this system

M/F	Age	MMSE	CDR	Group
M	87	27	0	Not Alzheimer
M	88	30	0	Not Alzheimer
M	75	23	0.5	Alzheimer
M	80	22	0.5	Alzheimer
F	88	28	0	Not Alzheimer
F	90	27	0	Not Alzheimer
M	80	28	0	Not Alzheimer
M	83	29	0.5	Not Alzheimer
M	85	30	0	Not Alzheimer
F	93	30	0	Not Alzheimer

For testing data, data is obtained from the results of questionnaires which are processed into MMSE and CDR values. The following is the processing of MMSE and CDR values:

1. Processing of MMSE values
   The value of the MMSE is the value of the questionnaire. Each question item has its own maximum value. For example, in the number one orientation section, there are 5 question points, namely year, season, month, date, and day. If the patient is able to answer all, it will be given 5 points, and if the patient is only able to answer 3, it will be given 3 points, and so on. To get the total value of the MMSE, all the values that have been achieved by the patient are summed up.

2. Processing of CDR values
   The CDR questionnaire has 6 parts, namely memory, orientation, assessment and problem solving, outside activities, homework and hobbies, and personal care. The answers of patients or patient companions are analyzed by a general practitioner, then assessed based on the CDR Rating Table that showed in Figure 1, where there are five ratings available for each part of the examination, namely 0(none), 0.5(questionable), 1(mild), 2(moderate), 3(severe) [16], [17]. The CDR value for testing data is a global CDR value, the value is obtained from 634 different combinations of score patterns [18]. Figure 2 is some possible combination of upcoming rating value patterns. For the complete combination of patterns can be seen on the biostat website [18].



CDR™ Scoring Table

Subject Initials _____

CLINICAL DEMENTIA RATING (CDR™):	0	0.5	1	2	3

	Impairment				
	None 0	Questionable 0.5	Mild 1	Moderate 2	Severe 3
Memory	No memory loss or slight inconsistent forgetfulness	Consistent slight forgetfulness; partial recollection of events; "benign" forgetfulness	Moderate memory loss; more marked for recent events; defect interferes with everyday activities	Severe memory loss; only highly learned material retained; new material rapidly lost	Severe memory loss; only fragments remain
Orientation	Fully oriented	Fully oriented except for slight difficulty with time relationships	Moderate difficulty with time relationships; oriented for place at examination; may have geographic disorientation elsewhere	Severe difficulty with time relationships; usually disoriented to time, often to place	Oriented to person only
Judgment & Problem Solving	Solves everyday problems & handles business & financial affairs well; judgment good in relation to past performance	Slight impairment in solving problems, similarities, and differences	Moderate difficulty in handling problems, similarities, and differences; social judgment usually maintained	Severely impaired in handling problems, similarities, and differences; social judgment usually impaired	Unable to make judgments or solve problems
Community Affairs	Independent function at usual level in job, shopping, volunteer and social groups	Slight impairment in these activities	Unable to function independently at these activities although may still be engaged in some; appears normal to casual inspection	No pretense of independent function outside home Appears well enough to be taken to functions outside a family home	Appears too ill to be taken to functions outside a family home
Home and Hobbies	Life at home, hobbies, and intellectual interests well maintained	Life at home, hobbies, and intellectual interests slightly impaired	Mild but definite impairment of function at home; more difficult chores abandoned; more complicated hobbies and interests abandoned	Only simple chores preserved; very restricted interests, poorly maintained	No significant function in home
Personal Care	Fully capable of self-care		Needs prompting	Requires assistance in dressing, hygiene, keeping of personal effects	Requires much help with personal care; frequent incontinence

Score only as decline from previous usual level due to cognitive loss, not impairment due to other factors.

10

Figure 1 CDR Scoring Table [17]

Number of Times A Box-Score Pattern Occurred. 1
Table is sorted in ascending box-score order.
(There have been 20401 assessments yielding 634 distinct box-score patterns.)
16:07 Wednesday, May 26, 2021

Memory Box Score	Orientation Box Score	Judgement & Problem Solving Box Score	Community Affairs Box Score	Home and Hobbies Box Score	Personal Care Box Score	Global CDR	Assessments With This Combination
0	0	0	0	0	0	0.0	10465
0	0	0	0	0	1	0.0	5
0	0	0	0	0.5	0	0.0	51
0	0	0	0.5	0	0	0.0	40
0	0	0	0.5	0.5	0	0.5	8
0	0	0	1	0	1	0.5	1
0	0	0.5	0	0	0	0.0	449
0	0	0.5	0	0	1	0.5	3
0	0	0.5	0	0.5	0	0.5	29
0	0	0.5	0	0.5	1	0.5	3
0	0	0.5	0.5	0	0	0.5	29
0	0	0.5	0.5	0	1	0.5	1
0	0	0.5	0.5	0.5	0	0.5	14
0	0	0.5	0.5	0.5	1	0.5	1
0	0	1	0	0	0	0.0	2
0	0	1	0.5	0.5	0	0.5	1
0	0	1	0.5	1	0	0.5	1
0	0	1	1	1	0	0.5	2
0	0.5	0	0	0	0	0.0	65
0	0.5	0	0	0.5	0	0.5	4
0	0.5	0	0.5	0.5	0	0.5	1
0	0.5	0.5	0	0	0	0.5	31
0	0.5	0.5	0	0.5	0	0.5	8
0	0.5	0.5	0	0.5	1	0.5	2
0	0.5	0.5	0.5	0	0	0.5	5
0	0.5	0.5	0.5	0	1	0.5	1

Figure 2 Combination of CDR value and Global CDR

2.2.1.2. Modeling SVM

SVM modeling is done using the library available in python, namely sklearn.svm. SVM modeling uses 80% training data and 20% testing data. Modeling coding with python is shown in Figure 3.

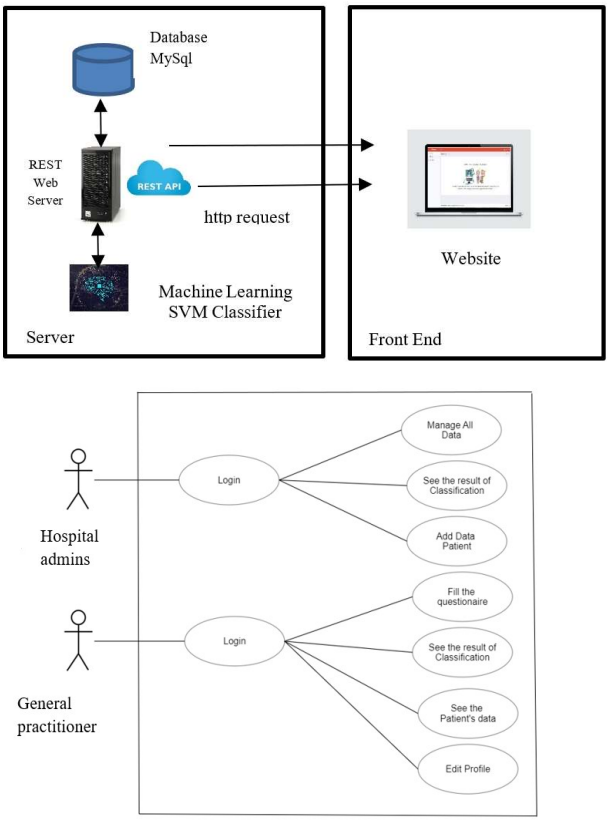
```
# SVM

from sklearn.svm import SVC

model = SVC(random_state=0)
model.fit(x_train, y_train)
```

Figure 3. Modeling SVM in Python

2.2.2. Web Design

Web Application of Alzheimer's Early Detection in the elderly using Flask Python, a web framework with python programming language. To access the data, the application uses a web server and a connected

database API. The API is also used to create a classification process and display an Web application. The architecture of alzheimer's early detection web application system is shown in Figure 4a. The users of this application are hospital admins and general practitioners. Admins have the authority to organize all data, view Alzheimer's classification results, and add patient data. General practitioners have the authority to fill out questionnaires, view Alzheimer's cassification results, view patient data, and edit profiles. The use case is shown in Figure 4b.



(a) (b)

Figure 4(a) Architecture System (b) Use case of Web System

In web application for early detection of Alzheimer's in the elderly using SVM Classifier, the hospital admin enters patient data, then general practitioner can see the patient's data and can start making a diagnosis by asking several questions to patient according to the questions in the MMSE questionnaire and CDR questionnaires and input the answers to the web. After the answer is submitted, then the server will process the results of the questionnaire to get the MMSE value and CDR value and store those values in the database. Data testing is already complete in the form of Gender, Age, MMSE, and CDR. Then a classification is carried out with the SVM Classifier and the classification results are stored in the database using attribut Group. The classification result is whether a person is Alzheimer's or not Alzheimer's. Workflow can be seen in Figure 5.

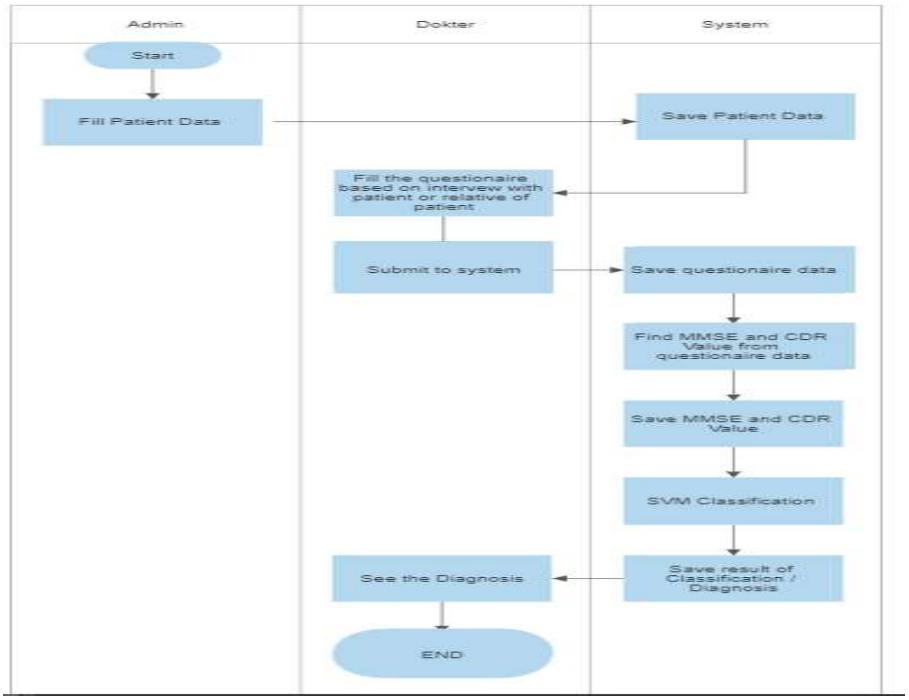


Figure 5 Workflow Web Application of Early Detection Alzheimer in Eldery

3. Result and Discussion

3.1. Implementation of Web Application of Alzheimer's Early Detection in Elderly

Web application of Alzheimer's Early Detection in elderly using Flask Python, a web framework with python programming language. This application has several function for hospital admins and general practitioners, such as login that shown in Figure 6. Hospital admins can add patient data as shown in Figure 7. Once the patient is added, the general practitioner can see the data patient as shown in Figure 8. And carry out the diagnosis by giving questions according to the MMSE and CDR questionnaires and fill in the answer to the system. The questionnaire filling page is shown in figure 9. The classification results are obtained after the questionnaire answers are submitted. Classification results in the form of patients classified as Alzheimer's or not Alzheimer's are shown in figure 10.

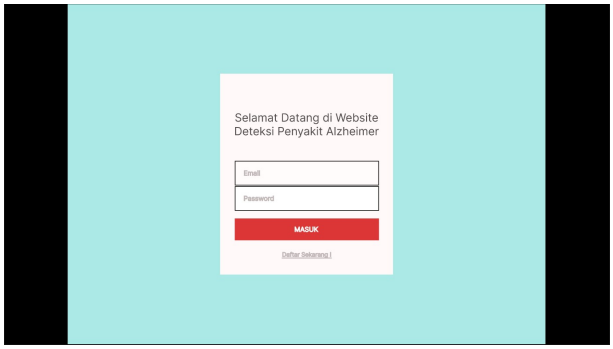


Figure 6. Login Page to Web Application Alzheimer's Early Detection in Elderly

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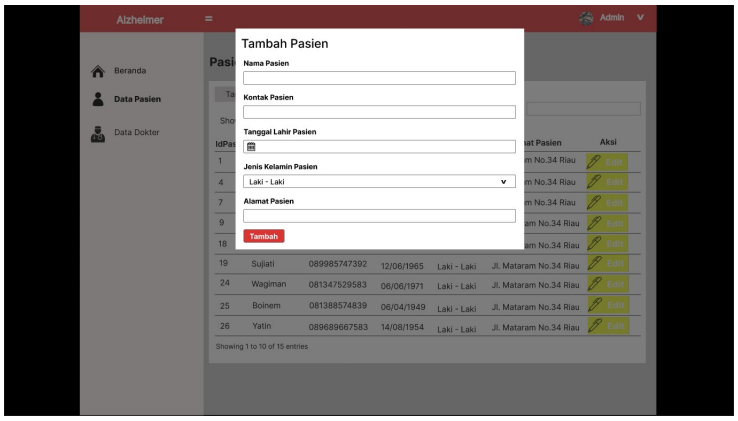

Figure 7. Page for adding patient

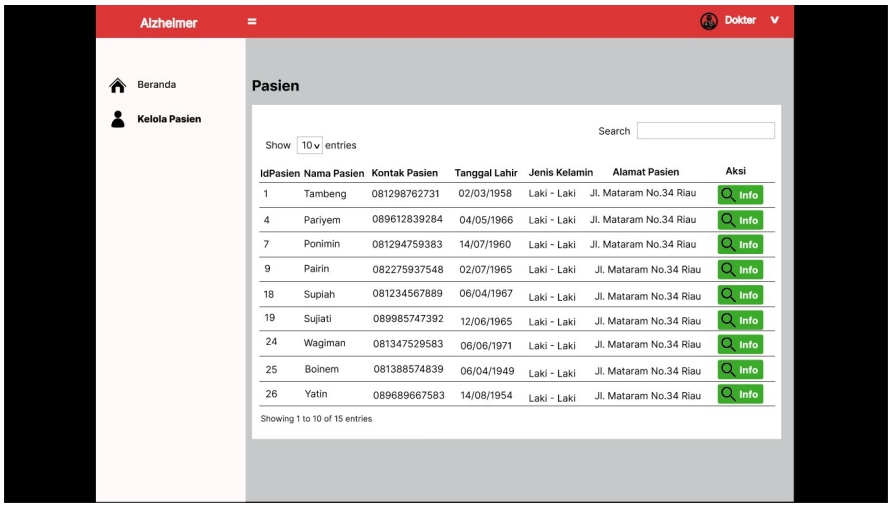

Figure 8 Data Patient page for General Practitioner

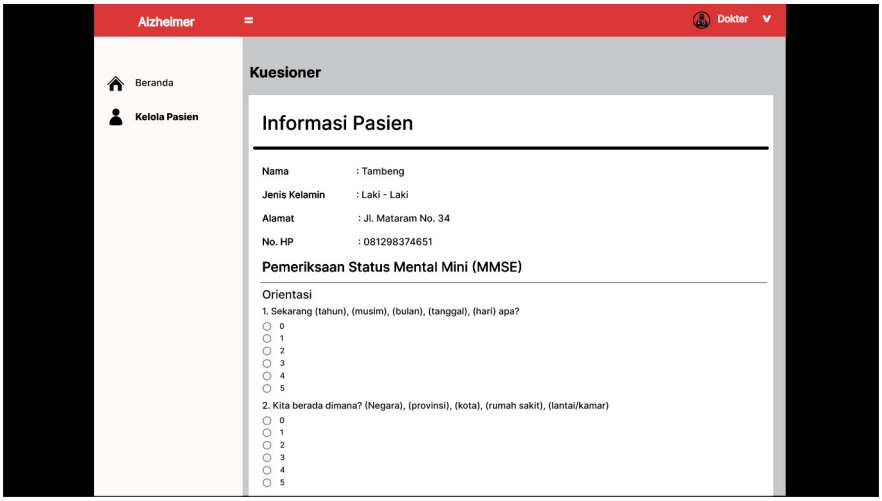

Figure 9 Filling page MMSE questionaire

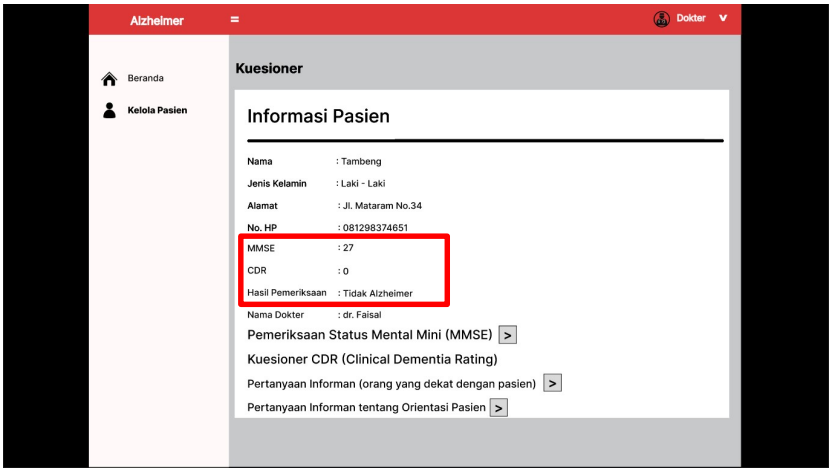

Figure 10. Result of Classification using SVM Classification

3.2. User Acceptance Test

User Acceptance Test testing is carried out to general practitioners, to find out whether the functions on the Web Application of Alzheimer's Early Detection in Elderly are functioning properly. The format of user acceptenace test is Black Box Testing.

Table 4. User Acceptance Test for Web Application of Alzheimer's Early Detection in Elderly

Test Class	Test Item	Conclusion Yes/No	Action
Register Doctor's Account	Display the account registration form and save the data	Yes	-
	Display the doctor login form and successfully enter the dashboard	Yes	-
Conducting diagnostics	View overall patient data	Yes	-
	Display the questionnaire form and successfully fill out the MMSE and CDR questionnaires	Yes	-
	Displaying MMSE and CDR calculation results	Yes	-
Support Vector Machine Classification	Classification of patient data in the form of Gender, Age, MMSE, CDR was successfully carried out	Yes	-
	Displaying the results of the classification on the results of the diagnosis	Yes	-

3.3. SVM Classification Testing using Confusion Matrix

SVM Classification that applied to web application alzheimer's early detection in elderly was evaluated using Confussion Matrix. In confussion matrix, the value of prediction using SVM Classification was compared to the real condition. Confusion matrix is used to measure the performance of SVM Classification with accuracy, precision, recall, and error [19], [20]. There are True Positive (TP), True Negative (TN), False Positive (FP), and False Negative (FN) in confussion matrix. The condition TP is if the predict value is positive then the real value is positif. The condition TN is if the predict value is negative then the real value is negative. The condition FP is if the predict value is positive then the real value is negative. The condition FN is if the predict value is negative

then the real value is positive. The result of testing is shown in Table 5. And the confussion matrix is shown in Table 6.

Table 5 Comparation Predicted Class and Actual Class

M/F	Age	MMSE	CDR	SVM Classification (Predicted class)	Actual class	Condition
M	87	27	0	Not Alzheimer	Not Alzheimer	True
M	88	30	0	Not Alzheimer	Not Alzheimer	True
F	78	23	1	Not Alzheimer	Alzheimer	False
F	79	29	0	Not Alzheimer	Not Alzheimer	True
M	80	22	0.5	Alzheimer	Alzheimer	True
F	88	28	0	Not Alzheimer	Not Alzheimer	True
F	90	27	0	Not Alzheimer	Not Alzheimer	True
F	73	25	0.5	Not Alzheimer	Alzheimer	False
M	80	28	0	Not Alzheimer	Not Alzheimer	True
M	83	29	0.5	Not Alzheimer	Not Alzheimer	True
M	85	30	0	Not Alzheimer	Not Alzheimer	True
F	93	30	0	Not Alzheimer	Not Alzheimer	True
F	71	28	0	Not Alzheimer	Not Alzheimer	True
F	78	29	0	Not Alzheimer	Not Alzheimer	True
M	66	25	0.5	Not Alzheimer	Alzheimer	False
F	80	29	0	Not Alzheimer	Not Alzheimer	True
F	83	29	0	Not Alzheimer	Not Alzheimer	True
F	81	30	0	Not Alzheimer	Not Alzheimer	True
F	82	30	0	Not Alzheimer	Not Alzheimer	True
F	61	30	0	Not Alzheimer	Not Alzheimer	True

Table 6. Confussion Matrix Table

	Predicted Class		
Actual Class		Alzheimer	Not Alzheimer
	Alzheimer	1	3
	Not Alzheimer	0	16

From Table confussion matrix there are some value of TP, TN, FP, FN:

1. True Positive (TP) = 1
2. True Negative (TN) = 16
3. False Positive (FP) = 0
4. False Negative (FN) = 3

And the accuracy, precision, recall and F1 value is shown in Equation (1), Equation (2), Equation (3), Equation (4).

$$The\ accuracy\ value = \frac{TP+TN}{TP+TN+FP+FN} = \frac{1+16}{1+16+0+3} = \frac{17}{20} = 0.85 = 85\% \quad (1)$$

$$The\ Precision\ value = \frac{TP}{TP+FP} = \frac{1}{1+0} = 1 = 100\% \quad (2)$$

$$The\ Recall\ value = \frac{TP}{TP+FN} = \frac{1}{1+3} = 0.25 = 25\% \quad (3)$$

$$Error = 100\% - accuracy = 100\% - 85\% = 15\% \quad (4)$$

Based on the results of the confusion matrix test, it was obtained: an accuracy value of 85% in Equation (1), a precision value of 100% in Equation (2), a recall value of 25% in Equation (3) and an Error value of 15% in Equation (4). The accuracy value describes how accurately the model is in classifying correctly. An accuracy value of 85% signifies the model is quite accurate in classifying Alzheimer's or Non-Alzheimer's for the elderly. Precision value is a measurements of how correctly prediction is made for a positive condition based on all positive predicted values (both TP and FP). In the study, the precision value is 100%, meaning that SVM can classify Alzheimer's conditions well. There is no patients who are Not Alzheimer's predicted Alzheimer's. The recall value is a measurement of how correctly the prediction is made for a positive condition based on all positive values. Signifies accuracy for positive values. In this study, the recall value was worth 25%, indicating that the accuracy to detect patients affected by Alzheimer's was still low, because someone who was Alzheimer's, the predicted results were not Alzheimer's. From the data of 4 people affected by Alzheimer's, only 1 is exactly predictable according to the actual condition. However, based on the 85% accuracy value, meaning that patients who do not have Alzheimer's, the predicted results are also Not Alzheimer's. However, based on the 85% accuracy value, meaning that patients who do not have Alzheimer's, the predicted results are also Not Alzheimer's. On data from 16 non-sufferers of Alzheimer's appropriately predicted Not Alzheimer's. And patients suffering from Alzheimer's, some are appropriately predicted Alzheimer's, some are predicted Not Alzheimer's. There is an error of 15%. From the test, it can be concluded that with an accuracy value of 85%, SVM can still do the classification well.

4. Conclusions

Early detection of Alzheimer's disease is made using MMSE questionnaires and CDR and then the results are automatically classified using a support vector machine algorithm. Based on the results of the Black Box testing carried out, the functional system implemented is as expected. Based on the results of the confusion matrix test, it was concluded that the system built using the support vector machine algorithm has a good accuracy value, namely with a score of 85%.

For the development of the next system, it can be developed by expanding the scope of testing or the scope of data retrieval by involving young patients. It uses a classification algorithm other than the support vector machine to compare accuracy values. The system can be developed with a mobile version.

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