

Expert System for Diagnosing Student Depression using the Certainty Factor Method

Elin Haerani¹, Novriyanto², Agesta Putrama³

Informatics Engineering UIN Sultan Syarif Kasim Riau
Jl. Subrantas Km. 15, Pekanbaru, 28293, 0761-562223

elin.haerani@uin-suska.ac.id¹, novriyanto@uin-suska.ac.id², ages.putrama@gmail.com³

Abstrak

Kurun waktu masa penyelesaian perkuliahan mahasiswa adalah antara 4 sampai dengan 7 tahun. Salah satu syarat kelulusan mahasiswa adalah melakukan penelitian tugas akhir atau skripsi. Dari pengumpulan data awal diketahui hanya sebagian kecil yang bisa menyelesaikannya tepat waktu. Banyak mahasiswa yang terlalu lama menyelesaikan kuliahnya, bahkan tidak selesai. Berbagai sebab dan alasan mahasiswa diantaranya, mahasiswa tidak menemukan judul yang tepat, putus asa ketika tidak menemukan literatur yang dibutuhkan dan takut untuk bertemu dosen. Hal tersebut dapat menjadi cikal bakal depresi pada mahasiswa akhir sehingga berdampak buruk pada penyelesaian kuliahnya. Untuk mengantisipasi permasalahan tersebut, maka dibangunlah suatu sistem pakar. Sistem pakar yang dibangun dapat menggantikan posisi seorang pakar yaitu seorang psikolog dalam membantu mahasiswa untuk mengetahui gejala dan penanganan terhadap depresi yang dialaminya. Dalam penelitian ini mengelompokkan depresi pada mahasiswa akhir dalam 3 tingkatan yaitu depresi ringan, depresi sedang dan depresi berat. Sistem pakar yang dibangun menggunakan metode Certainty Factor. Metode ini digunakan sebagai mesin inferensi yang mengkombinasikan 43 gejala untuk menghitung kemungkinan terhadap 3 tingkatan depresi. Sistem diuji dengan blackbox test, UAT (User Acceptance Test), dan tes akurasi dengan hasil 85%.

Kata kunci: Certainty Factor, Depresi, Mahasiswa, Pakar, Tugas Akhir

Abstract

The period of completion of student lectures is between 4 to 7 years. One of the requirements for student graduation is to do research on a final project or thesis. From the initial data collection, it is known that only a small part can complete it on time. Many students take too long to finish their studies, some even can't finish. There are various reasons for students, including students who do not find the right title, despair when they do not find the literature they need and are afraid to meet lecturers. This reason then became the forerunner of depression in students so that it had a bad impact on completing their studies. To anticipate these problems, an expert system was built that can replace the position of an expert. The expert in question is a psychologist who can help students to find out the symptoms and treatment for depression they are experiencing. In this study the grouping of depression in students was divided into 3 levels, namely mild depression, moderate depression and major depression. The system was built using the Certainty Factor method with forward chaining. This method is used as an inference engine that combines 43 symptoms to calculate the probability of 3 levels of depression. The system was tested with a blackbox test, UAT (User Acceptance Test), and an accuracy test with a result of 85%.

Keywords: Certainty Factor, Depression, Student, Expert, Final Project.

1. Introduction

Depression is an emotional condition that is usually characterized by extreme sadness, feelings of worthlessness and guilt (withdrawal, sleeplessness, loss of appetite, interest in daily activities). Depression is also a psychiatric disorder in the realm of feelings (affective/mood disorder) which is characterized by symptoms of moodiness, lethargy, lack of enthusiasm for life, feeling useless, deep disappointment, hopelessness, thoughts of death and suicidal ideation. The definition of depression is a feeling of sadness, pessimism, and feeling alone that is part of major depression and other mood disorders [3].

Students will undergo a minimum of three or four years of university studies, and will complete their studies by writing a thesis as a graduation requirement for a bachelor's degree.

This phase usually makes students stressed, as in research [4] which says that many students consider thesis writing a difficult and complicated phase because it requires more energy and thought to do it. Moreover, coupled with other factors that can hinder the work of the thesis.

The American College Health Association-National College Health Assessment (ACHA-NCHA) in 2011 examined the student journey from second to fourth year at various educational institutions in America. They found that 30% of students stated that they "feel so stressed that they can 'do nothing'". stress is included in the top ten difficulties for students related to mental health. This result was obtained after the institute analyzed data on 230 respondents consisting of students and graduates (57%), university staff (31%), and health workers (4%) [5].

There are no exact figures on depressed students in Indonesia. Literature studies show that stress on students tends to be high. The number of students experiencing academic stress increases every semester until the final semester. Lack of knowledge about how to deal with depression problems will lead to more serious depression events. Some examples that make depression a serious thing, one of which is the case of a 23-year-old student at a university in North Sumatra with the initials FAP, committing suicide because of a thesis deadline [7]. In 2018 there was also a suicide case for a 13th semester Padjadjaran University student with the initials RWP who allegedly committed suicide because he had family financial problems and an unfinished thesis. It describes the symptoms of depression in students ranging from low to extreme.

With the current use of computers that are used in various fields including medicine, the problems described can be helped by using a system technology, namely the Expert System. An expert system is a system that is integrated with computer equipment in which there is knowledge, facts, and reasoning techniques in solving problems that usually can only be solved by an expert in their field. In building this system, the confidence factor or certainty factor calculation method will be applied.

2. Literature Review

Depression is an emotion that arises in the midst of helplessness, individual failure, and arises when individuals seek to gain power that cannot be realized. According to [10] depression is a feeling (affective) disorder characterized by a dysphoric affect (loss of arousal / arousal) accompanied by other symptoms, such as sleep disturbances and decreased appetite.

Expert systems are a branch of AI that uses specialized knowledge extensively for expert human-level problem solving. An expert is a person who has expertise in a particular field, namely an expert who has special knowledge or abilities that other people do not know or are capable of in their field.

Certainty Factor is a theory used to accommodate the uncertainty of an expert's thinking (inexact reasoning), which was proposed by Shortliffe and Buchanan in 1975. An expert such as a psychiatrist often analyzes existing information with the expression of uncertainty, to accommodate this. we use the Confidence Factor to describe the level of expert confidence in the problem at hand.

The method in calculating certainty factor can be divided into 3 stages and with their respective conditions, as follows:

1) Combined or Combination Certainty Factor Method

- a. Condition 1: If the CF value of the two symptoms is more than zero ($CF1$ and $CF2 > 0$) or is negative then:

$$CF \text{ Combination} = (CF1 + CF2) * (1 - CF1)$$

- b. Condition 2: If the value of $CF1 < 0$ or $CF2 < 0$ then:

$$CF \text{ Combination} = \frac{CF1 + CF2}{1 - \min(CF1|CF2)}$$

- c. Condition 3: If the CF value of both symptoms > 0 ($CF1$ and $CF2 > 0$) or positive then:

$$CF \text{ Combination} = CF1 + CF2 * (1 - CF1)$$

2) Metode *Certainty Factor Sequential*

$$CF(H, e) = CF(E, e) * CF(H, E)$$

Information:

CF (E, e) = Certainty Factor evidence E which is influenced by evidence e.

MB (H,E) = Certainty Factor hypothesis assuming the evidence is known with certainty, namely when $CF(E,e) = 1$.

MD (H,E) = Certainty Factor hypothesis which is influenced by evidence e.

If all the evidence on the antecedents is known with certainty, the equation will be as follows:

$$CF(H, e) = CF(H, E)$$

3. Methodology

The research methodology explains the steps taken in research so that problems can be solved in accordance with the expected results and objectives. The methodology used is the ESDLC (Expert System Development Life Cycle) model [16], the following is the application of the research methodology adapted based on the research conducted:

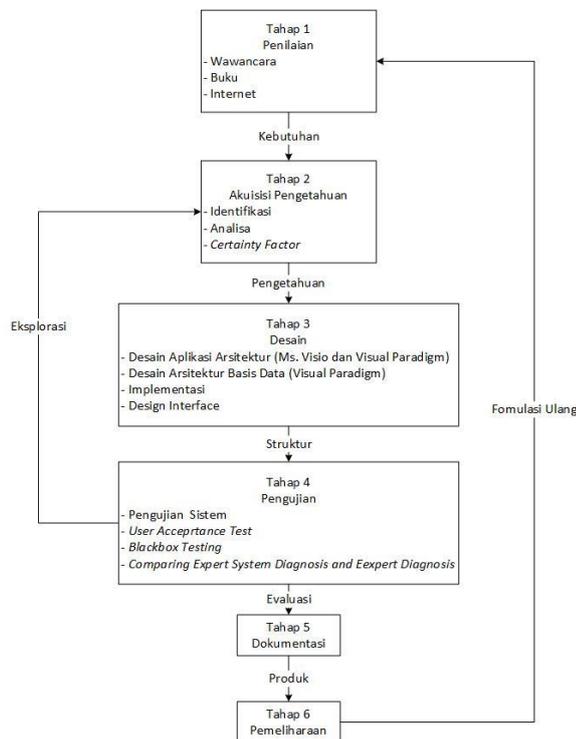


Figure 1. Research Methodology

4. Results and Discussion

4.1. System analysis

The analysis of the old system in this study can be seen in the flowchart of the old system, the following is an explanation of the flow of the old system with the flowchart as follows:

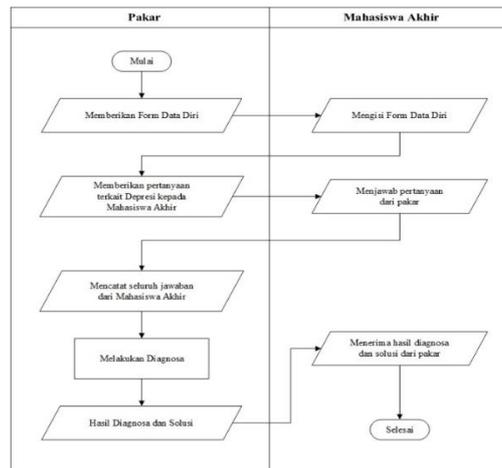


Figure 2. Flowchart of the Previous System

The new system that will be built is a system that can utilize expert expertise in diagnosing depression in final year students. This system is a system that will make it easier to diagnose because it will save time and costs. The expert system built will apply the Certainty Factor method and use the Forward Chaining tracing model. The system to be built uses the PHP programming language, MySQL database and the Laravel framework. The following is an overview of the flowchart of this new system:

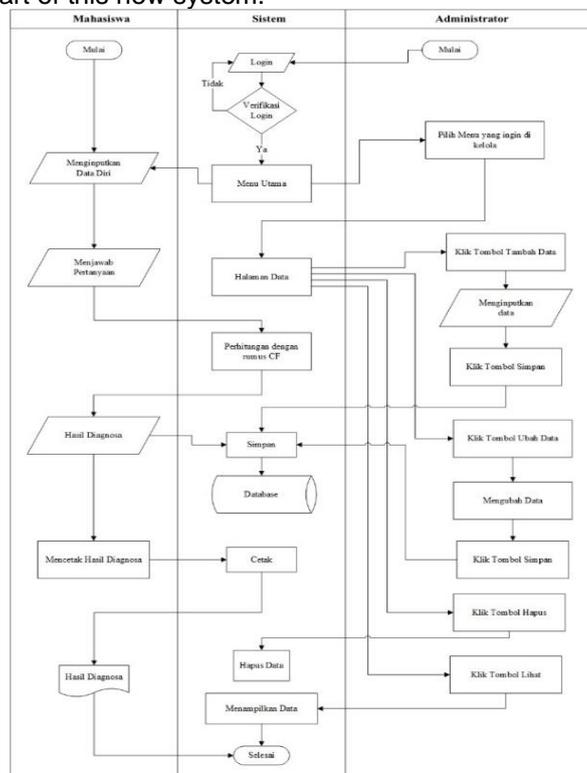


Figure 3. Flowchart of New System

4.3. Knowledge Base Analysis

The knowledge base can be said to be the core in building an expert system, this is because the knowledge base will be represented as questions that are used as the basis for diagnosing students, then the knowledge base is also the basis for determining the severity of depression felt by these final year students. The following is the data used for the knowledge base on this system. Data Tingkat Depresi

Depression level data is data used to distinguish the severity of depression felt by final students, the following table for the student's depression level code data:

Table 1. Depression Level Code

No.	Kode	Persentase Tingkat Depresi	Solusi Penanganan
1.	M1	M1 0% to 50% (Mild Depression)	It is better to find a friend or a close person to express the problem. Start looking for a counselor or professional to prevent further stress.
2.	M2	M2 51% to 80% (Medium Depression)	Need special therapy to eliminate problems with the mental approach to therapy or consultation with a psychiatrist.
3.	M3	M3 81% to 100% (Severe Depression)	Special treatment is needed to solve mental problems.

1) Depression Symptom Data

Table 2. Common Depression Symptoms

No.	Code	Symptom of Depression
1.	D1	Feeling tired when you wake up in the morning
2.	D29	Feeling all activities make you tired
3.	D2	Having insomnia
4.	D3	Daydreaming alone
5.	D4	Easily angry over trivial things
6.	D5	Feeling lazy to work all day
7.	D10	Feeling headache for no reason
8.	D12	Feeling bored with life
9.	D21	The body's response is slow
10.	D17	Easy to forget
11.	D22	Feeling out of control of yourself
12.	D20	My face looks gloomy
13.	D23	Loss of motivation to do hobbies
14.	D24	Decreased appetite
15.	D30	Easy to panic
16.	D39	Difficulty controlling our breath when faced with a job that is considered difficult
17.	D42	It's hard to smile at other people
18.	D43	Feeling suicidal
19.	D41	The body trembles when faced with a job that is considered difficult

Table 3. Symptoms of Informatics Engineering Student Depression

No.	Code	Symptoms of Depression
1.	D14	Trouble finding the title of the thesis
2.	D16	The topic of the thesis that is taken does not match your interests
3.	D15	Do not know and do not master the problems that will be raised in the thesis
4.	D6	The literature that is owned is incomplete
5.	D7	Fear and anxiety when communicating with supervisors
6.	D8	Fear of being wrong in expressing opinions with mentors
7.	D9	Fear of not being able to answer questions from the supervisor
8.	D25	Feeling that the thesis you have is not of high quality
9.	D26	Not used to writing scientific papers
10.	D32	Lack of interest and motivation in learning
11.	D33	Unable to create and develop software (Software)
12.	D31	Lazy to talk about scripts
13.	D40	Often feel anxious thinking about things related to thesis work
14.	D36	Thinking about thesis makes students nauseous
15.	D37	Breaking a cold sweat when working on a thesis
16.	D35	Difficulty concentrating while attending lectures
17.	D38	Difficulty concentrating when doing college assignments
18.	D27	Lecture activities feel boring
19.	D34	Lecture activities are difficult
20.	D18	Decreasing quality of work done
21.	D28	Easily offended by other people's words about the thesis
22.	D19	Anxious when receiving advice from others
23.	D11	Loss of motivation to study
24.	D13	Heart pounding while working on thesis

2) Data Bobot Nilai *Certainty Factor*

The *Certainty Factor* value is the value of an expert regarding the belief in a symptom against a diagnosis. The following *Certainty Factor* values are the results of interviews with two experts, who are Mental Therapists and Clinical Psychologists. The following is the confidence value data from the expert (*certainty factor*).

Table 4 Value of CF (Certainty Factor)

No.	Code	Value			CF (MB-MD)
		MB	MD	CF	
1.	D1	0.5	0.3	0.2	
2.	D2	0.5	0.3	0.2	
3.	D3	0.7	0.3	0.4	
4.	D4	0.6	0.2	0.4	
5.	D5	0.5	0.1	0.4	
6.	D6	0.2	0.1	0.1	
7.	D7	0.5	0.2	0.3	
8.	D8	0.4	0.1	0.3	
9.	D9	0.5	0.2	0.3	
10.	D10	0.7	0.2	0.5	
11.	D11	0.8	0.4	0.4	
12.	D12	0.8	0.3	0.5	
13.	D13	0.5	0.1	0.4	
14.	D14	0.3	0.1	0.2	
15.	D15	0.3	0.1	0.2	
16.	D16	0.3	0.1	0.2	
17.	D17	0.4	0.1	0.3	
18.	D18	0.5	0.1	0.4	
19.	D19	0.7	0.3	0.4	
20.	D20	0.7	0.3	0.4	
21.	D21	0.9	0.2	0.7	
22.	D22	0.8	0.1	0.7	
23.	D23	0.7	0.2	0.5	
24.	D24	0.8	0.4	0.4	
25.	D25	0.4	0.2	0.2	
26.	D26	0.2	0.1	0.1	
27.	D27	0.3	0.1	0.2	
28.	D28	0.5	0.1	0.4	
29.	D29	0.6	0.2	0.4	
30.	D30	0.5	0.1	0.4	
31.	D31	0.3	0.1	0.2	
32.	D32	0.3	0.1	0.2	
33.	D33	0.4	0.1	0.3	
34.	D34	0.5	0.3	0.2	
35.	D35	0.5	0.1	0.4	
36.	D36	0.6	0.2	0.4	
37.	D37	0.7	0.2	0.5	
38.	D38	0.5	0.2	0.3	
39.	D39	0.8	0.2	0.6	
40.	D40	0.8	0.3	0.5	
41.	D41	0.7	0.1	0.6	
42.	D42	0.8	0.3	0.5	
43.	D43	0.9	0.1	0.8	

4.4. Functionality Analysis

Functional analysis conducted in this study includes Usecase Diagrams, Sequence Diagrams, Class Diagrams, and Deployment Diagrams. The following is an explanation of each analysis of the functionality of this expert system:

a. Use Case Diagram

Use Case Diagrams state the visualization of interactions that occur between users (actors) and the system, and there are 2 important elements that must be explained in this Use Case Diagram, namely actors and use cases, where actors are everything that interacts directly with the system :

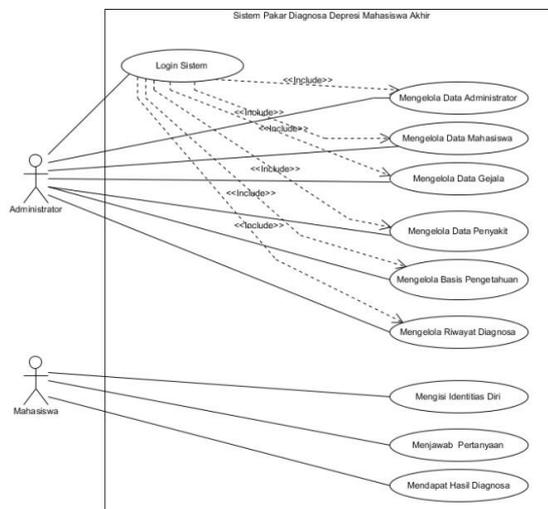


Figure 4. Use Case Diagram

b. Class diagram

Class diagram is a description of the system structure based on the definition of the classes used to build a system, and in these classes there are attributes and methods/operations in it, where attributes are variables owned by a class, while operations or methods are functions. in class. The following is an overview of the Class Diagram of the Final Year Student Depression Diagnosis Expert System:

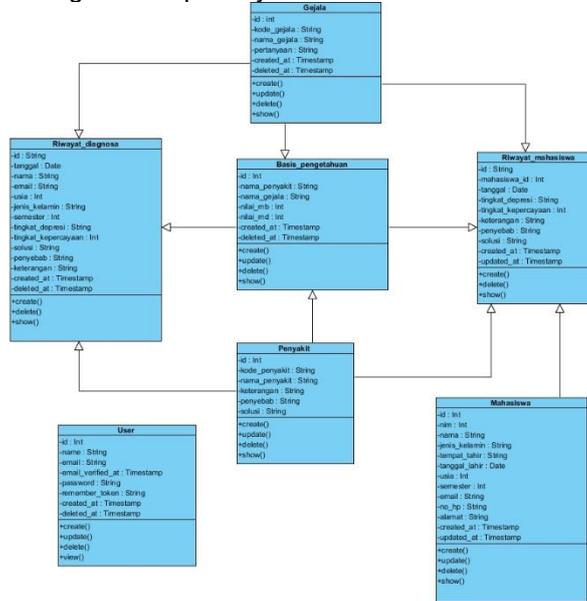


Figure 7. Class Diagram

4.5. Implementation and Testing

After going through the stages, the designed system is then implemented, where at this stage all previous views of the previous design are made as close as possible and as good as possible. The implementation of each of these systems can be seen in the following explanation:

a. Website Home View

This page is the start page of a system, with various information about Depression and other menus such as “About, HOME, and Login”, here is how it looks:



Figure 8. Website Home Screen

b. Diagnostic Results Page

After going through the "Diagnosis" page and the student has filled in all the answers on the diagnosis page, the student will get the results of the diagnosis, and the following is the display of the diagnostic results:

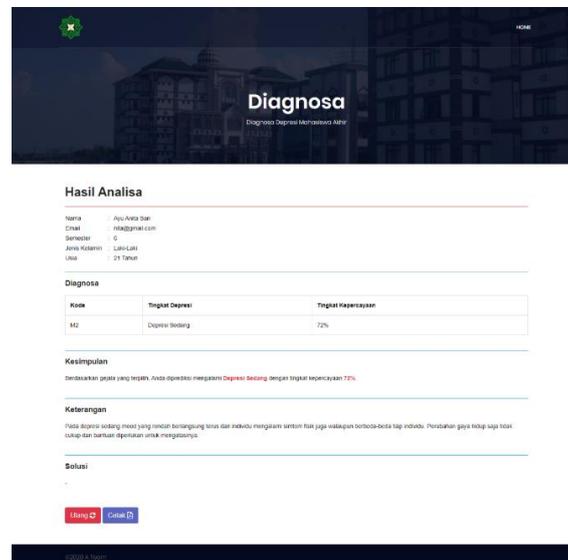


Figure 9. Diagnostic Results Page

After doing Black Box testing, User Acceptance Test, Comparing expert systems with expert diagnoses, and Confusion Matrix, several conclusions were obtained, namely:

- In blackbox testing, it can be concluded that all buttons and menus have functioned as expected, without any errors.
- In the UAT (User Acceptance Test) test, it can be seen that the system functions, system appearance, and all things related to the system are appropriate. This is evidenced by the results of the Expert UAT, which is 92% (Strongly Agree/Very Good) from the results of the UAT 2 Experts, and the student UAT results of 93% (Strongly Agree/Very Good) from 15 students.
- In testing, comparing the diagnosis of the expert system with the diagnosis of the expert, shows that the system has been running well, with the correct diagnosis results.
- In the test comparing the results of system diagnostics and expert diagnostic results using 20 student diagnostic data, the system accuracy is 85%.

6. Conclusion

The final conclusion in building an expert system for diagnosing student depression is that this system has succeeded in implementing the Certainty Factor method for calculations in diagnosing depression levels in final students. In Black Box Testing, it can be seen that the system has been running as expected.

Further research can be done to get better results, there are some suggestions from the author for the development of this expert system, namely: adding other supporting parameters in the identification process such as adding symptoms related to depression and adding experts to get better results. The expert system method used not only uses the certainty factor method, but can be developed by comparing with other expert system methods such as the Naive Bayes method, the Dempster Shafer method and the fuzzy logic method.

References

- [1] Davison, T. E., & McCabe, M. P. (2006). Adolescent body image and psychosocial functioning. *Journal of Social Psychology, 146*(1), 15–30. <https://doi.org/10.3200/SOCP.146.1.15-30>.

- [2] Hawari, D. (2010). Psikopatologi Bunuh Diri. *Jakarta : Balai Penerbit FK UI.*
- [3] Kaplan, H.I & Sadock, B. J. (1996). Pocket Handbook of Clinical Psychiatry. *Baltimore : Williams and Wilkins*
- [4] Panjaitan, Y. V. Z. (2014). *Hubungan Antara Optimisme Dengan Stres Pada Mahasiswa Yang Sedang Menyusun Skripsi.* Universitas Katolik Soegijapranata Semarang.
- [5] Student Minds. (2014). *Grand Challenges in Student Mental Health.* 48.
- [6] Purwati. (2012). Tingkat Stres Akademik pada Mahasiswa Reguler Angkatan 2010 Fakultas Ilmu Keperawatan Universitas Indonesia. *Ui.*
- [7] Muhardiansyah, Y. (2014). Diduga stres gara-gara skripsi, mahasiswa USU gantung diri. Retrieved from <https://www.merdeka.com/peristiwa/diduga-stres-gara-gara-skripsi-mahasiswa-usu-gantung-diri.html>.
- [8] Putra, W. (2018). Diduga Stres Skripsi, Mahasiswa Unpad Gantung Diri di Indekos. Retrieved from detikNews website: <https://news.detik.com/berita-jawa-barat/d-4357539/diduga-stres-skripsi-mahasiswa-unpad-gantung-diri-di-indekos>.
- [9] Seligman, M. E. P. (1993). *What You Can Change and What You Cant : The Complete Guide to Successful Self Improvement.* New York: Fawcett Columbine.
- [10] Lubis, N. L. (2009). *Depresi: Tinjauan Psikologis* (1st ed.). Jakarta.
- [11] Maslim, R. (2011). *Diagnosa Gangguan Jiwa Rujukan Ringkas PPDGJ-III.* Jakarta: PT. Nuh Jaya.
- [12] Dahria, M. (2011). Pengembangan Sistem Pakar Dalam Membangun Suatu Aplikasi. *Jurnal Saintikom.*
- [13] Durkin, J. (1994). *Expert systems design and development.* New York: Macmillan.