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Mobile-Based Application Implementing the Dempster-Shafer Method for Diagnosing Post-Traumatic Stress Disorder (PTSD)

Dini Ridha Dwiki Putri[1], Muhammad Reza Fahlevi[2], Fetty Ade Putri[3], Ulfah Indriani[4], Miftahul Mardiyah[5], Diaz Andreansyah[6]

[1,2,3,4,6]Universitas Potensi Utama, Medan, Indonesia
[5]STIKES Mitra Sejati, Medan, Indonesia
Email: putrydiny11@gmail.com[1], ezafahlevi72@gmail.com[2], echiputri12@gmail.com[3], ulfahindriani90@gmail.com[4], miftahulmardiyah5@gmail.com[5], diazandreansyah@gmail.com[6]

Abstract

Post-Traumatic Stress Disorder (PTSD) is a serious mental health condition that can develop after an individual experiences a traumatic event. Early diagnosis of PTSD symptoms is crucial to prevent more severe psychological and social impacts. This study aims to develop a mobile-based expert system application that implements the Dempster-Shafer method to independently diagnose the confidence level of PTSD symptoms. The system is designed with three main components: biodata input, a symptom selection interface based on 9 indicator questions, and an inference engine utilizing the Dempster-Shafer method with a Likert scale to assess the severity of trauma experienced by respondents. Testing was conducted on 47 respondents, and the analysis results showed that 19.1% were in the safe category, 4.3% in mild PTSD, 12.8% in moderate PTSD, and 63.8% in severe PTSD. Validity testing indicated that all symptom items had correlation values (r-calculated) greater than 0.2876, confirming their validity, and the instrument's reliability was measured at $\alpha = 0.806$. The application is capable of providing an initial diagnosis along with recommended actions based on the severity level of PTSD. This study demonstrates that applying the Dempster-Shafer method in a mobile application offers an effective, efficient, and accessible alternative solution for early PTSD diagnosis, especially for individuals with limited access to professional mental health services.

Keywords: *PTSD, Mobile Application, Expert System, Dempster-Shafer Method, Mental Health Services.*

1. Introduction

Post-Traumatic Stress Disorder (PTSD) is a serious psychological condition that can emerge after an individual experiences a traumatic event, such as natural disasters, armed conflict, accidents, physical violence, sexual abuse, humiliation, rejection, loss, or even the prolonged psychological impact of the COVID-19 pandemic. PTSD symptoms often resemble those of generalized anxiety disorder, panic disorder, or depression, making it difficult to distinguish without proper intervention. Key symptoms include flashbacks, nightmares, and heightened emotional or physical responses to trauma-related stimuli. PTSD is among the mental health disorders with the highest risk of suicide compared to other anxiety-related conditions. It often disrupts daily functioning, including difficulties with concentration, impaired social relationships, and decreased performance in work or academic settings.

Several studies indicate that approximately 56.4% of individuals with PTSD have experienced suicidal ideation or behavior [1]. According to data from the World Health Organization (WHO), PTSD is classified as an anxiety disorder whose prevalence continues to rise globally, particularly in the aftermath of the COVID-19 pandemic, which has placed considerable pressure on the public's mental health. Early diagnosis of PTSD is

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critical to prevent more severe consequences, such as suicidal tendencies and disruptions to social functioning. However, the limited availability of mental health professionals and the persistent stigma surrounding psychological disorders often hinder individuals from accessing appropriate mental health services [2].

With the advancement of information technology—particularly the development of mobile applications—there is now an opportunity to provide mental health services that are more accessible, affordable, private, and efficient. One promising approach for digital diagnostic systems is the Dempster-Shafer Method, an evidential reasoning technique capable of managing uncertainty in decision-making processes. This method offers advantages in enhancing diagnostic accuracy based on symptom data provided independently by the user [3].

This study aims to develop a mobile application utilizing the Dempster-Shafer method to enable users to conduct early self-diagnosis of PTSD symptoms. The application is expected to serve as an alternative solution for individuals with limited access to professional mental health services while also helping to reduce risks associated with delayed diagnosis of PTSD symptoms [4].

2. Research Methodology

2.1. Research Subject

The subjects of this study are individuals who have the potential to experience Post-Traumatic Stress Disorder (PTSD), particularly those who have gone through traumatic events such as accidents, violence, natural disasters, humiliating experiences, loss, or other life-threatening situations. The study focuses on respondents aged 17 to 30 years who are capable of using a smartphone and can independently report their psychological condition through the developed application. The symptom data entered by the respondents is used to evaluate the effectiveness of the expert system that applies the Dempster-Shafer method in detecting the confidence level of potential PTSD symptoms. This application is designed as an early diagnostic support tool and is not intended to replace clinical diagnosis. Nevertheless, it provides users with initial information and self-guided recommendations related to their psychological condition.

2.2. Expert System

One of the relevant applications of Artificial Intelligence (AI) in the field of mental health is the expert system. An expert system is a branch of AI designed to mimic the reasoning and decision-making processes of a human expert in analyzing symptoms and solving problems within a specific domain. In the context of this study, the expert system is utilized to assist in the early self-diagnosis of Post-Traumatic Stress Disorder (PTSD) symptoms and to provide users with appropriate solution recommendations [6].

2.3. Dempster-Shafer Method

This study applies the Dempster-Shafer Method, a reasoning approach based on evidential theory that is effective for decision-making under conditions of uncertainty. The method accommodates non-monotonic reasoning, in which conclusions may change as new information becomes available. To address such inconsistencies, the Dempster-Shafer method is employed for its ability to manage and combine evidence with varying degrees of belief [6]. The implementation of this method aims to enhance the accuracy in calculating the confidence level of the likelihood that an individual may be experiencing Post-Traumatic Stress Disorder (PTSD) based on symptoms independently selected by the user. The following is a flowchart illustrating the application of the Dempster-Shafer method [7]:

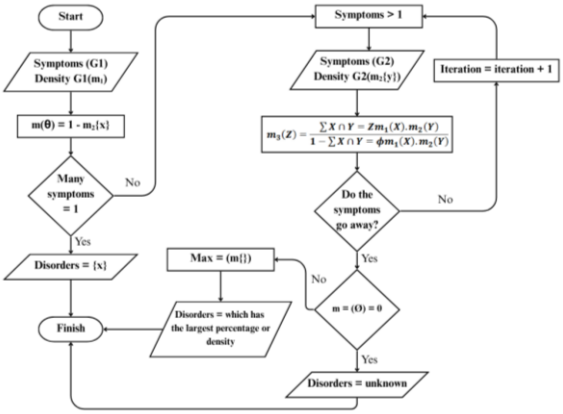

Figure 1. Flowchart Metode Dempster Shafer

2.4. System Design

This mobile application was developed using Android Studio and the Java programming language, consisting of three main components as follows:

a. Biodata Input: Users are asked to fill in personal information such as name, age, gender, and history of trauma experienced.
b. Symptom Selection Interface: This consists of 9 question items formulated based on the diagnostic criteria for PTSD, as outlined in the DSM-5 or modified from the PHQ-9 instrument, including [8]:

Table 1. Symptoms

Code	Symptoms
G1	Experiencing flashbacks or nightmares about the traumatic event
G2	Avoiding conversations or places that serve as reminders of the trauma
G3	Having feelings of guilt or excessive self-blame
G4	Loss of interest in activities that were previously enjoyable
G5	Difficulty sleeping or experiencing recurring nightmares
G6	Easily startled, overly alert, or frequently experiencing emotional outbursts
G7	Difficulty concentrating or feeling detached from the surrounding environment
G8	Unable to recall important parts of the traumatic event
G9	Feeling hopeless about the future

Each symptom question uses a Likert Scale to measure the frequency or intensity of the symptoms experienced by the respondent, with the following options:

Table 2. Likert Scale

No.	Likert Scale	Density Value
1.	Never	0.00
2.	Rarely	0.30
3.	Sometimes	0.60
4.	Often	0.90

c. Inference Engine: A reasoning engine based on the Dempster-Shafer method is implemented to process the symptom inputs and generate a belief value indicating the severity level of PTSD, which is categorized into the following levels [9]:

Table 3. PTSD Severity Level and Solution

Percentage Rate	PTSD Severity Level	Solution
> 75%	High	Immediately consult a mental health professional (psychologist or psychiatrist), consider trauma-focused

Percentage Rate	PTSD Severity Level	Solution
		therapy such as CBT or EMDR.
50–74,99%	Moderate	Practice self-care, have an initial consultation with a psychologist or psychiatrist, and engage in meditation, relaxation, and education on stress and emotion management.
31–49,99%	Low	Monitor your symptoms regularly, avoid trauma triggers, and continue to maintain your mental well-being.
< 30%	Safe	Safe condition. Maintain a healthy lifestyle, practice self-control, and continue self-education. No immediate clinical action is required.

3. Results and Discussion

At this stage, analysis and application testing were conducted using respondent data obtained from completed questionnaires. The data were processed and subjected to instrument validity testing to ensure the accuracy and reliability of the responses, thereby producing optimal diagnostic results.

3.1. Validity Test of Respondent Instrument

To ensure that the questionnaire items used in the application accurately measure PTSD symptoms, a validity test was conducted on the questionnaire data completed by 47 respondents. The instrument consisted of 9 PTSD symptom items, each answered using a 4-point Likert Scale: Never (0), Rarely (1), Sometimes (2), and Often (3). The validity test was carried out by calculating the item-total correlation using statistical software (SPSS) [10]. The results showed that all items had r-calculated values greater than the r-table value at a 5% significance level with N = 47 (r-table ≈ 0.2876), as presented in the table below [11]:

Table 4. Validity Test of Respondent Instrument

Code	Symptoms	r-calculated	r-table	Validity
G1	Experiencing flashbacks or nightmares about the traumatic event	0.573	0.2876	Valid
G2	Avoiding conversations or places that serve as reminders of the trauma	0.538	0.2876	Valid
G3	Having feelings of guilt or excessive self-blame	0.726	0.2876	Valid
G4	Loss of interest in activities that were previously enjoyable	0.719	0.2876	Valid
G5	Difficulty sleeping or experiencing recurring nightmares	0.603	0.2876	Valid
G6	Easily startled, overly alert, or frequently experiencing emotional outbursts	0.571	0.2876	Valid
G7	Difficulty concentrating or feeling detached from the surrounding environment	0.711	0.2876	Valid
G8	Unable to recall important parts of the traumatic event	0.553	0.2876	Valid
G9	Feeling hopeless about the future	0.641	0.2876	Valid
Cronbach's Alpha Result		0.806		Reliable

Thus, all symptom items were declared valid and suitable for use in the PTSD symptom diagnostic process. In addition, the instrument's reliability was tested using Cronbach's Alpha, which yielded a value of $\alpha = 0.806$, indicating a high level of internal consistency. Therefore, all questions (symptoms) in the questionnaire were considered reliable.

3.2. Results

Below are the display and diagnostic results from the mobile application in diagnosing Post-Traumatic Stress Disorder (PTSD).

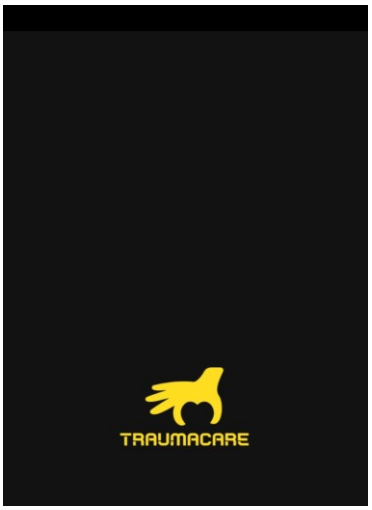

Figure 2. Splash Page When the Application is Launched

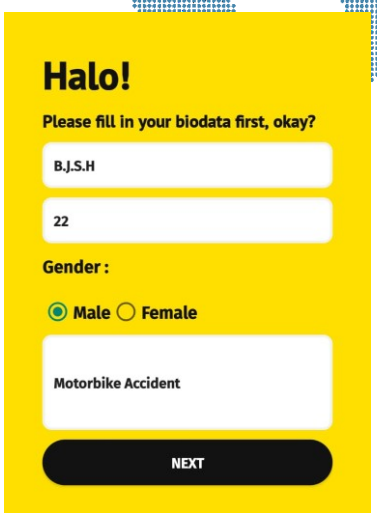

Figure 3. User Biodata Input Page

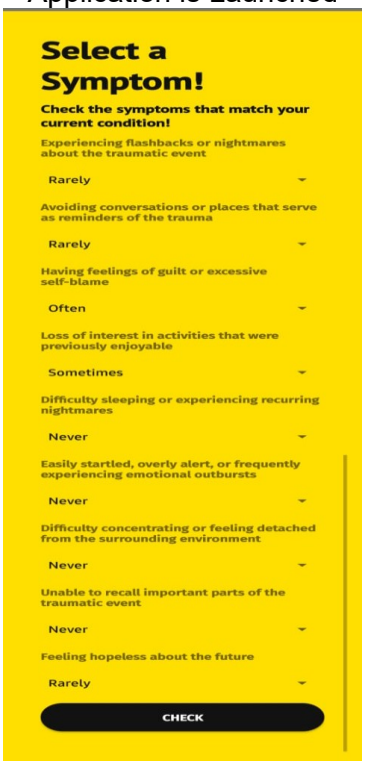

Figure 4. Consultation Page for Selecting Likert Scale for Each Symptom

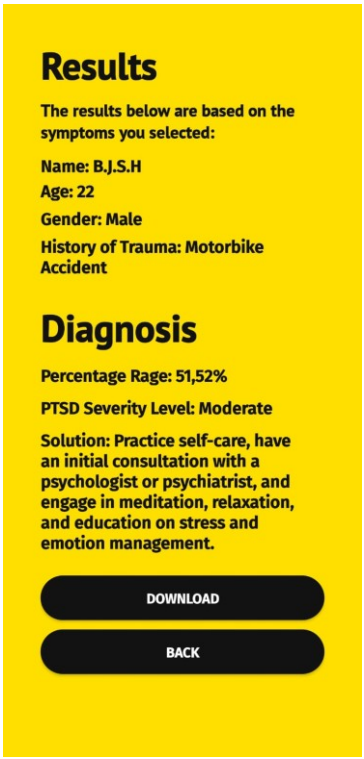

Figure 5. PTSD Diagnosis Result Page

Table 5. Respondent Questionnaire and Diagnostic Results

Respondent	Age	Gender	Percentage Rate	PTSD Severity Level
D.K.	20	Male	78,81%	High
R.A.P.S.	21	Male	3,26%	Safe
M.I.N.W.	20	Male	86,01%	High
N.F.L.	19	Female	99,79%	High
N.J.T.Z.	20	Female	100,00%	High
D.R.	19	Male	98,56%	High
D.F.	20	Male	100,00%	High

Respondent	Age	Gender	Percentage Rate	PTSD Severity Level
R.R.S.	20	Male	4,82%	Safe
M.F.S.P.	20	Male	78,20%	High
Z.R.P.M.	22	Male	100,00%	High
M.F.R.N.	21	Male	20,99%	Safe
H.D.	20	Male	97,00%	High
B.J.S.H.	22	Male	51,52%	Moderate
M.A.A.H.	20	Male	41,47%	Low
M.S.	21	Female	99,99%	High
I.S.	20	Female	78,81%	High
M.B.	21	Male	69,23%	Moderate
W.W.	21	Female	2,12%	Safe
Y.S.	23	Female	20,39%	Safe
A.J.	22	Male	31,29%	Low
T.F.	20	Female	78,20%	High
S.H.	23	Male	100,00%	High
A.O.T.	19	Female	92,87%	High
M.I.K.	21	Male	99,45%	High
B.T.S.	20	Male	99,91%	High
M.F.S.	20	Male	1,43%	Safe
R.R.	20	Male	94,96%	High
R.P.	21	Male	97,00%	High
F.H.L.	20	Male	0,40%	Safe
M.F.	29	Male	59,12%	Moderate
D.A.	21	Male	93,48%	High
D.A.A.A.	20	Male	100,00%	High
M.P.A.	19	Female	84,80%	High
T.A.	19	Female	78,81%	High
M.I.N.R.	20	Male	100,00%	High
R.S.Y.A.	22	Male	98,74%	High
R.A.	21	Male	99,89%	High
H.S.B.	21	Female	50,61%	Moderate
N.P.	21	Male	100,00%	High
R.O.M.	22	Male	60,58%	Moderate
A.A.	18	Male	71,26%	Moderate
R.S.S.	23	Male	0,00%	Safe
A.Z.	21	Male	20,99%	Safe
R.P.	19	Male	100,00%	High
W.	23	Male	99,96%	High
D.P.	21	Male	99,91%	High
N.A.S.	21	Female	99,98%	High

Based on the diagnostic results conducted on 47 respondents, consisting of 35 males and 12 females, using a mobile application based on the Dempster-Shafer method, the severity levels of PTSD were identified as follows [12]:

a. 9 respondents (19.1%) were categorized as Safe, indicating no significant signs of PTSD symptoms.
b. 2 respondents (4.3%) were identified as experiencing Mild PTSD, which can be managed through self-care and regular symptom monitoring.
c. 6 respondents (12.8%) were classified as having Moderate PTSD, requiring further attention and possible consultation with a mental health professional.
d. 30 respondents (63.8%) were found to have Severe PTSD, with a high confidence level in the presence of symptoms, indicating the need for immediate clinical intervention.

These results indicate that 80.9% of respondents exhibited symptoms of PTSD at varying levels of severity, suggesting that this disorder is relatively common, especially

following traumatic events. The fact that only 19.1% of respondents were in a safe condition highlights the critical importance of early PTSD diagnosis awareness.

4. Conclusion

This study successfully developed a mobile-based expert system application implementing the Dempster-Shafer method to enable independent diagnosis of Post-Traumatic Stress Disorder (PTSD) symptoms. The application features a simple and intuitive interface and utilizes a 4-point Likert scale to measure the intensity of 9 PTSD symptoms entered by the user. The inference process is conducted by combining the belief values of each symptom to determine the severity level of PTSD, categorized as safe, mild, moderate, or severe. Based on testing with 47 respondents, it was found that 19.1% were in the safe category, 4.3% experienced mild PTSD, 12.8% moderate PTSD, and 63.8% severe PTSD. These findings indicate that 80.9% of respondents showed signs of PTSD with varying severity, highlighting the importance of early diagnosis. The validity test of the instrument showed that all items had r-calculated values > 0.2876, indicating validity, while the reliability test using Cronbach's Alpha yielded a score of 0.806, indicating strong internal consistency. Overall, this application has proven capable of providing accurate and informative early diagnoses, along with follow-up recommendations based on calculated belief levels. The implementation of the Dempster-Shafer method in a mobile platform has proven effective in addressing diagnostic uncertainty and offers an alternative solution that can reach a broader population, especially those with limited access to professional mental health services.

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