Diagnosis of Mental Disorder and Stress Self-Treatment using Rule-Based Technique

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Abstract: Every year, over one million people died by suicide worldwide. 6.7% of them are due to depression. High depression are the one of the prevalent mental disorder problems. They are less visible and can be continuously revised. Therefore, this study develops a Mental Disorder Diagnosis and Stress Self-Treatment System. This system offer users with the set of questionnaire in order to measure the stress, anxiety and depression. The questionnaire is generated using rule-based techniques. Besides, weighted sum method is also used to calculate the sum of answer from the users. If the feedbacks shows the positive mental health problems, the users are given the stress self-treatment. In addition, this system can be used at all times and anywhere.

Key words: Mental Disorder Problems • Stress Self-Treatment • Rule-based Technique

INTRODUCTION

A mental disorder is a health problem that significantly affects how a person feels, thinks, behaves and interacts with other people [1]. Besides, can be characterized by the absence of positive effect (a loss of interest and enjoyment in ordinary things and experiences), persistent low mood and a range of associated emotional, cognitive, physical and behavioural symptoms [2].

About 450 million people suffer from mental disorders worldwide. One person in four will develop one or more of these disorders during lifetime [3]. Other research findings indicate that about one in five Australians aged 16-85 years experiences a mental disorder at some time in their lives [4]. One in four Europeans report they have suffered from at least one mental disorder during their lifetime [5]. In the USA 26.2% of the population, 60 million people, suffer from at least one form of mental disorder [6]. Mental disorders represent not only an immense psychological, social and economic burden to society, but also increase the risk of physically illnesses [3].

In light of that, there is a need to a system that can diagnose early mental disorders problem and self-stress treatment. Besides, can initiate public awareness of the mental disorders problem. In 2010, Kroenke et al. [7], proposed a review on patient health questionnaire somatic, anxiety and depressive symptom scale. Besides, Richardson et al. [8] evaluated the patient health questionnaire of 9 items for detecting major depression among adolescents. Donker et al. [9] reviewed the use of mobile phone applications (apps) provides the opportunity to increase accessed to the evidence-based mental health care. Bakker et al. [10] reviewed and recommended an evidence-based for future developments of mental health smartphone apps. Based on the previous studies, many currently available mental disorder applications (apps) are focused only on the mental disorder problems and lacked with the features of stress self-treatment. Besides, lack with a complete system due to the trial-based evidence only [10].

Thus, the proposed of this study is to develop a Mental Health Diagnosis and Stress Self Treatment system which is a free apps. This system covers the functionality on level of stress, anxiety and depression of the user based on the set of questions via rule-based techniques. Besides, it provides a self-treatment to the users based on the level of mental healthiness via weighted sum method by suggesting some activities and advises to the users. This system also provides some suggestions on the mental health treatment from a qualified doctor.

The rest of the paper is organized as follows, the development of the system is provided in the System Construction and Software Implementation section. The result of this project in the form of system user interfaces and successful test are given in Testing and Validation section. Lastly, the Conclusion section summarizes the finding of this paper.
System Construction: This section focuses on constructing the mental disorders and stress self-treatment system. It includes design of the system, planning, implementation and achievement of the system.

The development of this system starts with the initial planning, where all the activities are planned according to the given period to complete the system. Next, the analysis of user and system requirement are identified in the requirement phase.

Then, analyse and design phase focuses the system to develop a prototype based on the functionalities once the requirement phase is completed. The rule-based technique is applied in this phase. The knowledge on mental disorders are collected based on previous study by McShane and Glinow [11] and transformed into the rules based in a form IF-THEN rules. Rules are made to be accurate by getting assistance from the medical experts. Then, all rules are changed into the coding using some programming tools. The general IF-THEN rules is stated as follows;

IF $x_i$ is $F_i$ and $x_j$ is $F_j$ THEN $I_i$

The rules are usually expressed in two parts which is IF part called antecedent or premise (or condition) and the THEN part is called consequent or conclusion (or action) [12]. If the rules is of multiple structure (usually combination of rules using AND and OR operator), it can decomposed into much simple rules [13]. Example of simple and multiple rules are as follows:

- IF condition THEN action.
- IF condition 1 OR condition 2.. OR condition N THEN action.
- IF condition 1 AND a condition 2.. AND condition N THEN action.

In this paper, the proposed system is divided into three different tests which are stress, anxiety and depression. Let us take one example for stress test. We used fourteen (14) questions of stress test taken from McShane and Glinow [11]. The list of questions are stated as follows:

$Q1$: In the last month, how often have you been upset because of something that happened unexpectedly?

$Q2$: In the last month, how often have you felt that you were unable to control the important things in your life?

$Q3$: In the last month, how often have you felt nervous and stressed?

$Q4$: In the last month, how often have you dealt successfully with irritating life hassles?

$Q5$: In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?

$Q6$: In the last month, how often have you felt confident about your ability to handle your personnel problems?

$Q7$: In the last month, how often have you felt that thing were going in your way?

$Q8$: In the last month, how often have you found that you could not cope with all things that you had to do?

$Q9$: In the last month, how often have you been able to control irritations in your life?

$Q10$: In the last month, how often have you felt that you were on top of things?
Q11: In the last month, how often have you been angered because of things that were outside your control?

Q12: In the last month, how often have you found yourself thinking about things that you have to accomplish?

Q13: In the last month, how often have you been able to control the way you spend your time?

Q14: In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

Thus, the users need to choose among 5 answers which are:

0: never; 1: almost never; 2: sometimes; 3: fairly often; 4: very often

Thus, the rules for stress test level will be:

IF
Q1 is 2 and Q2 is 1 and Q3 is 3 and Q4 is 4 and Q5 is 1 and Q6 is 2 and Q7 is 3 and Q8 is 3 and Q9 is 1 and Q10 is 0 and Q11 is 3 and Q12 is 1 and Q13 is 4 and Q14 is 3

THEN
moderate stress

There are three (3) different score level which are starting from 0 till 56, where;

0 - 19: Low stress
20 - 39: Moderate stress
40 - 56: High stress

The score level can be calculated using weighted sum method. If there are $M$ alternative and $N$ criteria then, the best alternative is the one that satisfies the maximization case of the following expression:

$$ P_i = \sum_{j=1}^{N} a_{ij} w_j \quad \text{for} \quad i = 1, 2, 3, \ldots, M. $$

where $P_i$ is the WSM score of the best alternative, $N$ is the decision number of criteria, $a_{ij}$ is the actual value of the $i$-th alternative in term of the $j$-th criterion and $w_j$ is the weight of importance of the $j$-th criterion. The assumption that governs this model is the additive utility assumption. That is the total value of each alternative is equal to the sum of the products given. This study chose the weighted sum method due to the precise and accurate results for the test that has been conducted.

Next is the implementation phase. In this phase, the system as shown as Figure 2 is divided into several sub-modules and actual coding based on the system requirements. The database is an important part in the development of the rule-based system. It is used for storing all information needed for the mental disorders. For this purpose, the MySQL is used as part of the database and PHP language as a tool for implementation. The inference process manipulates the knowledge base to deduce information requested by the user and carries out the reasoning required by the expert system to reach a solution. It links the rules given in the knowledge base with the facts store in the database. For example, if the results turn out to be no depression, thus system concludes the user have a happy life and healthy. However, the system suggests the patient for further treatment at the hospital via doctor’s suggestion if the results turn out to be moderate stress. Next section discusses on the next phases which are testing and validation of the system.

Testing and Validation: System testing and validation is performed to test if the functionality abides the initial requirement specification set by the users. This stage is important to ensure the system free from error before releasing for use. The errors such as logic errors, debugging, successful link between the module or menu, rules checking and sample field are all tested. The validation concern with diagnostic result so as to closely match the views of human experts. The testing are summarized as Figure 3 till 7 as follows;

Figure 3 shows the main menu of the system. This main menu, provides information on the system, login button for users, admin and doctor.

Figure 4 provides questionnaire to perceive the level stress, anxiety and depression. Users are required to answer all the questions and click the submit button at the end of the test.

The rule-based technique and weighted sum model are applied to achieve the final results. Results of the mental disorders will appear as in Figure 5. Here, the score level of mental disorder and recommendation are well appeared.

The system also provides a page where users can communicate with the doctor personally for the consultation as shown in Figure 6.
Fig. 2: The Inference Process of Mental Disorder and Stress Self-Treatment System

Fig. 3: Main Menu Form

Fig. 4: Test Mental Health Form
Fig. 5: Results for Test Mental Health

Fig. 6: Consultation for Stress Self Treatment

Fig. 7: Results for Stress Self Treatment
Once users answered the questionnaire, the system will record all the type of test, score, level of illness, recommendation and the date test was taken such in Figure 7.

**CONCLUSIONS**

This paper proposed a rule-based technique for diagnosing the mental disorders and stress self-treatment. Three different tests which are stress, anxiety and depression are offered to the users. The results for all tests were provided with the recommendation from the doctor. The system seems helps the user diagnosed their mental disorder based on every level; stress, anxiety and depression. Besides, gives an awareness to users for early recovery.

**REFERENCES**