

Design of Decision Support System for Diagnosis of Psychological Disorder

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ABSTRACT

In this research article, author have proposed a machine learning based framework to identify and diagnose a psychological disorders. The main objective of our research is to develop a decision support system to handle psychological disorders. Based upon basic symptoms of disorders, fuzzy rules have been designed for diagnosis. This system takes the input as physical and emotional symptom of the patient and diagnoses the particular disorder related to the psychology disorder. The performance of the system was analyzed by comparing the result of various type psychological disorders with the clinical report of the patients. The results obtained were up to the mark.

Keywords: Psychological disorder; fuzzy logic ; machine learning ; DSS.

INTRODUCTION

Psychological disorder is a transform of mental or behavioral status that makes sufferings. This affect day routine as well as the capacity to do the work. In many cases even the patient don't know about this problem i.e. he don't have an idea that he is suffering from psychological disorder. Some of the major categories of the psychological disorder includes Anxiety disorder, Mood disorder, Psychotic disorder, Eating disorder, Impulse control and addiction disorders and Personality disorders etc. Although the treatment for all these types of disorders can be done and the person suffering from these disorders can again live his life normally but diagnosis of these disorder is the basic steps for the treatment. Diagnose of the psychological disorder is not an easy job because in most of the cases patient is not able to explain his problem to the doctor [1-3][34]. Even the doctors also need a lot of experience to handle the patients suffering from psychological disorder. Even in many cases patient did not accept that he is suffering from his disorder and thus did not follow the proper treatment. There are many behavior and physical symptoms used to diagnose the psychological disorders. So an automated system (expert system) can help the doctors to diagnose of the psychological disorders. The main objective of this research is to develop a decision support system related to different parts of the body that means this expert system will deal with the various specialists for detecting the disorder. Due to non-availability of the expert in remote areas, most of the patient suffers from some danger disorder. Sometime patient's life in danger. It may lead to death because of the improper diagnosis of the disorder and treatment of those disorders. This expert system will very help:

- To develop a solid research foundation and comprehension of the logical establishment of brain science. To build up an information base of human conduct over the wide zones of brain research and become aware of the applications of psychology in the professions associated with psychology.
- To analyze various measuring parameters (physical & emotional symptoms) with accuracy dependency of the expert system.
- Defining psychological disorders allows psychologists to treat clients effectively.

PROBLEM WITH EXISTING MANUAL SYSTEM:

Early career psychologists often find it challenging to diagnose disorders. What makes this task particularly difficult is the fact that many disorders show a large overlap in terms of their symptoms, e.g. there can be significant weight loss in an eating disorder such as anorexia nervosa, but the same can apply to an affective disorder such as major depression. Current diagnostic manuals such as DSM IV (Diagnostic and Statistical Manual of Mental Disorders) or ICD 10 (International Statistical Classification of Diseases and Related Health Problems, 10th Revision) are books listing a large amount of symptoms assigned to disorders. Due to the aforementioned symptom overlap, however, this format makes it difficult to establish a diagnosis, as the symptoms of different disorders constantly need to be compared with each other until a diagnosis can be formed. Another problem with using book-format is the fact that disorders are described on separate pages, and going back and forth to compare symptoms and symptom combinations can take a considerable amount of time. An alternative solution would be an automated system that would permit the psychologist to enter symptoms and to get feedback from a database listing possible disorders. Such a system would mimic an expert's behavior, in this case a clinical psychologist searching for symptoms/symptom combinations and underlying disorders in a diagnostic manual. Rather than manually applying this procedure by referring to the aforementioned manuals in book-format, this system would search through the entire database of symptoms and disorders. A few favorable circumstances of proposed framework are given beneath:

- First, the programmed search would be a lot quicker than a manual inquiry.
- Second, this framework would be unmistakably more dependable than a human master, given the indications are entered effectively into the information base. The human master may make a blunder in the huge number of recorded manifestations/indication blends.
- Third, novel exploration discoveries about side effects and fundamental issues can be refreshed more effectively in an information base than in a book. At last, the graphical UI in the robotized rendition permits the clinician to enter manifestations by basically tapping on side effects that are available and by getting prompt input. This spares time over recording side effects during the medical procedure and later allocating these manifestations to a fundamental problem. Additionally, an electronic record of the manifestations can be put away in the framework and is promptly available to other medical services experts through the information base. This is worthwhile over making manual records of manifestations, which would need to be gone into an information base later. Every one of these models spare important time that can be spent on the consideration for the customer. Prior to going into specialized subtleties, we might want to give an overall presentation on master frameworks and backing this presentation by down to earth models from our framework.

DECISION SUPPORT SYSTEM (DSS): It is define as a computerized program that is used to support in taking decisions. Further the DSS helps in determinations, judgments, and courses of action in an organization or a business. A DSS works on the massive data. It examine the data by going through it and then compiling comprehensive information that can be used to solve problems and in decision-making.

CATEGORIES OF MENTAL DISORDERS: Mental disorder can be broadly classified into following six categories. This categorization is based upon different conditions that are recognized as psychological health disorders. In the following figure 1, categorization of various psychological disorders has been shown.

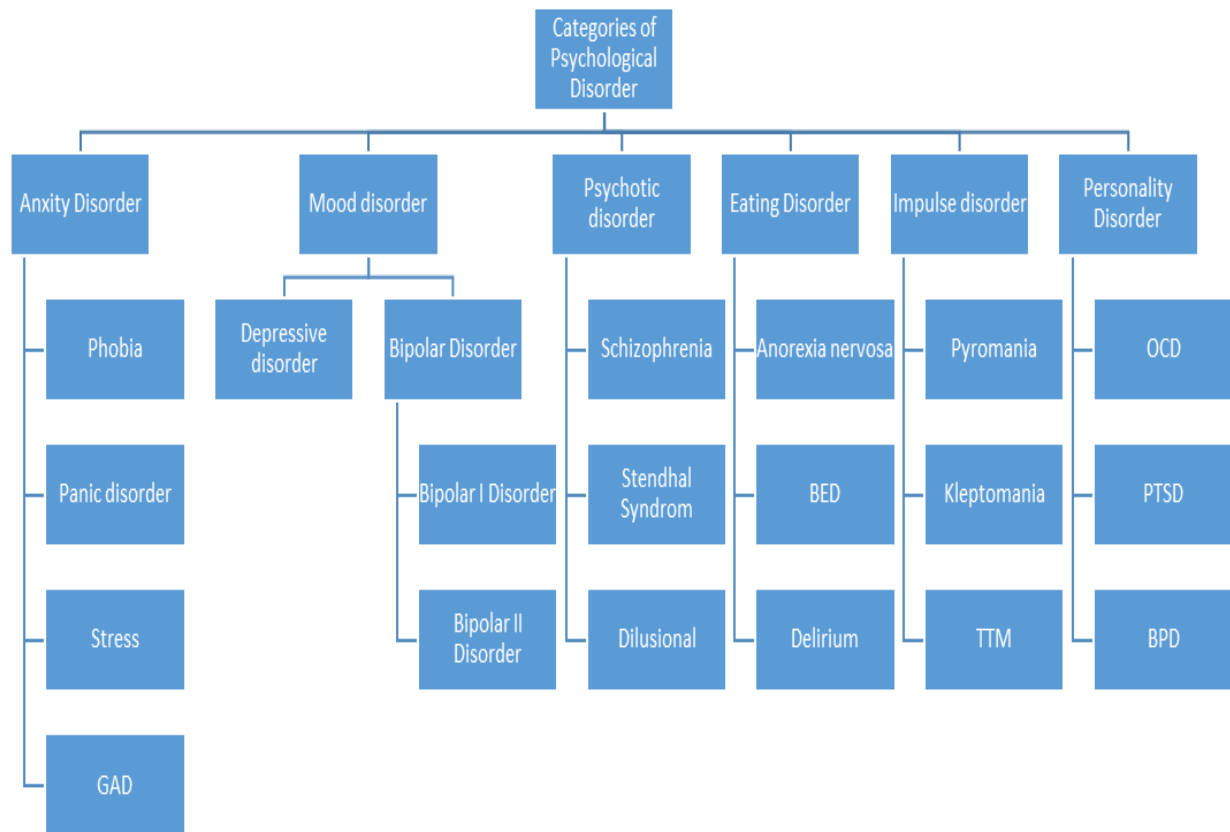


Figure 1: categorization of various psychological disorders

A brief introduction of these six psychological disorders is provided below:

- 1. Anxiety Disorders:** Anxiety is a vague, uncomfortable feeling of fear, dread, or danger. Anxiety disorders are a group of psychiatric conditions that involve anxiety. Symptoms can vary in severity and length. According to the Anxiety Disorders Association of America, the four anxiety disorders are identified as: Panic Disorder, Generalized Anxiety Disorder (GAD), Stress Disorder and Phobia.
- 2. Mood Disorders:** it is related to emotional problems, include diligent sensations of misery or times of feeling excessively glad, or changes from outrageous satisfaction to extraordinary trouble. The most well-known state of mind issues are discouragement, which torments 9.4 million Americans in any half year time span and bipolar issue.
- 3. Psychotic Disorders:** These issues include misshaped mindfulness and thinking. Two of the most well-known indications of insane problems are fantasies—the experience of pictures or sounds that are not genuine, for example, hearing voices; and dreams—deceptions that the evil individual acknowledges as evident, in spite of proof in actuality. Schizophrenia is an illustration of a maniacal issue.
- 4. Eating Disorders:** Eating disorders such as anorexia, and binge eating disorder include extreme emotions, attitudes, and behaviors surrounding weight and food issues. While eating disorders may begin with preoccupations with food and weight, they are most often about much more than food. Eating disorders arise from a variety of physical, emotional, social, and familial issues, all of which need to be addressed for effective prevention and treatment. Eating disorders are real, complex, and devastating conditions that can have serious consequences for health, productivity, and relationships. Eating disorders are

complex conditions that can lead to significant physiological changes that require medical treatment in to psychiatric treatment.

5. **Impulse Control and Addiction Disorders:** Individuals with impulse control issues can't avoid desires, or motivations, to perform acts that could be hurtful to themselves or others. Arsonist tendencies (lighting fires), thievery (taking) and trichotillomania are instances of drive control problems. Liquor and medications are regular objects of compulsion. Frequently, individuals these issues become so associated with the objects of their fixation that they start to overlook duties and connections.
6. **Personality Disorders:** People with character issues have extraordinary and firm character characteristics that are troubling to the individual and additionally mess up work, school or social connections. Furthermore, the individual's examples of reasoning and conduct altogether contrast from the desires for society and are inflexible to the point that they meddle with the individual's capacity to work successfully. Models incorporate post awful problem, over the top enthusiastic character issue (normal fanatical considerations incorporate topics of viciousness, dread of germs or potentially contamination, and questions about one's character and additionally conduct), and marginal character issue.

EXISTING APPROACHES:

In this section authors have presented a number of published literatures and researches on subjects associated to or may have a potential relevance to the work. The collected literature was reviewed to place the research in these fields and the outcomes were too large to be cited comprehensively here.

Ritu, and Sharma (2020). An extensive analysis regarding prevalence and diagnosis of neurological disorders using different data mining techniques have been presented. [2]. Kaur, Prableen, and Manik Sharma (2020) Presented a framework to diagnose the neurological disorders using emerging computing techniques [3]. Riza et al. (2017) explained sleep disorder is an anomaly that could cause problems for someone's sleeping pattern. Nowadays, it becomes an issue since people are getting busy with their own business and have no time to visit the doctors. Therefore, this research aims to develop a system used for diagnosis of sleep disorder using Fuzzy Rule-Based Classification System (FRBCS). FRBCS is a method based on the fuzzy set concepts. To validate the system that has been made, some experiments have been done using data from a psychiatric hospital in West Java, Indonesia. Accuracy of the result and computation time is 84.85% and 0.0133 seconds, respectively [22]. Hassan Ali (2017) in his research described that mental health problems have always existed in human life. However, factors such as lifestyle changes and industrialization affect modern human mental health. A common mental illness is depressive disorder, and a large number of patients are not even aware they have it. Due to the harmful influences of depressive disorder on quality of life, timely and accurate diagnosis is a matter of extreme prominence Sensitivity and specificity analysis are performed with 238 participants. The proposed system appears helpful for everyone, from ordinary persons to specialists in medical environments. It can also be useful to train psychology students in the area of diagnostic reasoning [9].

Meysam and Haleh (2017) proposed that the diagnostic parameters included the duration of diabetes, the score of a symptom examination based on the Michigan questionnaire, the score of a sign examination based on the Michigan questionnaire, the glycolysis haemoglobin level, fasting blood sugar, blood creatinine, and albuminuria. The output variable was the severity of diabetic neuropathy which was shown as a number between zero and 10, had been divided into four categories: absence of the disease, (the degree of severity) mild, moderate, and severe. The interface of the system was designed by ASP.Net (Active Server Pages Network Enabled Technology) and the system function was tested in terms of sensitivity

(true positive rate) (89%), specificity (true negative rate) (98%), and accuracy (a proportion of true results, both positive and negative) (93%) [13]. Subhagata Chattopadhyay (2017) describe that how specialists clinically see the side effects and afterward analyze gloom states. As per Demonstrative and Measurable Manual (DSM)- IV-TR, fourteen indications of grown-up despondency have been thought of. The heap of every indication and the comparing seriousness of wretchedness are estimated by the therapists (for example the space specialists). Utilizing the Central Segment Investigation (PCA) out of fourteen side effects (as highlights) seven has been extricated as dormant variables. Utilizing these highlights as data sources, a crossover framework comprising of Mamdani's Fuzzy rationale regulator (FLC) on a Feed Forward Multilayer Neural Net (FFMNN) has been created. The yield of the cross breed framework was tuned by a back engendering (BPNN) calculation. At last, the model is approved utilizing 302 genuine grown-up misery cases and 50 controls (for example typical populace). The examination presumes that the half breed regulator can determine and grade despondency to have a normal exactness of 95.50%. At last, it is contrasted and the correctnesses acquired by different procedures [20]. Mrs. Usha P Kosarkar1 . Mrs. Deepali Bhende (2016) in their research proposed to help the Malaysian brain research industry in diagnosing and treating their psychological patients, and furthermore to permit each psychological patient to have a few choices on choosing a treatment plan that accommodates their financial plan without risking their general medical issue. MeHDES will utilize three man-made brainpower (simulated intelligence) thinking procedures: rule-based thinking, fluffy rationale, and fluffy hereditary calculation (fluffy GA). The human specialists' information in the region of emotional well-being and issues will be changed and encoded into an information base utilizing the standard based thinking procedure; fluffy rationale at that point permits the seriousness level of a specific issue to be estimated; and fluffy GA will be utilized to decide and propose the appropriate treatment for every one of the psychological patients dependent on their spending plan and their general medical issue [14].

Prachi Goel (2014) describe about the design of the Expert System for Medical Assistance in Disruptive Mood Disorders is shown as implementation. Medical Science has been taking continuous efforts in the research and spread of awareness on the covert stress building up in an individuals' life. Due to an exhaustive routine, there is a tendency of the amplitude of this stress elevating thus causing disorders of many kinds. One of this being mood disorders, which goes undetected most of the time. It can also portray the role of a working memory and an inference engine to develop the rule logic with the former handling the users view and latter handling the methodology of producing the output to the user[16]. Rachna Ahuja , Darvinder Kaur (2014) describe about the prediction of disorder is difficult than prediction of disease and Autism is one of the mental disorder which affect the person social life and communication. Social and communication are important factor in life. This paper presented a neuro-fuzzy technique that is used to predict patient autism level based on various parameters like social levels and communications and emotional and behavior levels. As the communication and social parameters are very important in life so this paper uses the soft computing technique firstly neural technique is used for predicting whether the patient is autistic or not after than applying the fuzzy rules to find the autism level. level will describe the patient is low , medium or highly autistic. By determining the level of autism patient can be provided better treatment. In the future work can be done by taking more parameters and increase the dataset [18]. Hans-Ulrich Wittchen(2013) provided an overview of the theoretical framework of the Psychological Sciences' reviews and describes how improved psychological research can foster our understanding of mental health and mental disorders in a complementary way to biomedical research. Core definitions of the field and of psychological interventions and treatment in particular are provided. [23]. Swati Jain et al (2013) describes that the Soft reckoned scientific discipline is creating sever atomic number single 3 possible

action in bioinformatics, by generating first precision (approximate), good result. Bioinformatics is an interdisciplinary query area that is the exploiter user interface between the biological and reckoning all skills. Bioinformatics plenty with algorithmic dominion, selective information base and data organization of conventions, web applied scientific discipline skill, artificial tidings and soft computation machine skill, information and computing possibility [21].

Luciano Comin Nunes (2013) describe the main causes of low productivity at work, absence from work hours and even disability professionals, are the psychological disorders. Which most often manifests as psychotic disorders, mood disorders, anxiety disorders, antisocial personality, multiple personality disorder and substance abuse, causing damage to the person himself, his family and to the productive system in the country [12]. Anna Yankovskaya, Sergei Kitler (2013) proposed Mental Disorder Diagnostic System Based on Logical-Combinatorial Methods of Pattern Recognition describe mental disorder diagnostic system based on logical-combinatorial methods of pattern recognition called as the intelligent system DIAPROD-LOG. The system is designed for diagnostics and prevention of depression. The mathematical apparatus for creation of the proposed system based on a matrix model of data and knowledge representation, as well as various kinds of regularities in data and knowledge are presented. Further investigations are devoted to the intelligent system DIAPROD-LOG approbation [1]. EKONG, Victor E.I et al (2013) reports the discoveries from the test investigation of a smart framework driven by Fuzzy Logic (FL) for sorrow hazard determination. Despondency is a typical mental problem that can cause genuine wellbeing challenges on the off chance that it stays undiscovered, misdiagnosed or untreated. It speaks to a significant general medical condition recognized by the world wellbeing association (WHO) to have influenced a greater part of the profitable grown-up populace. The confounding idea of the sickness indications makes it hard for doctors utilizing psychometric evaluation devices alone to decide the seriousness of the infection. The system is implemented and simulated using MATLAB fuzzy tool box. The result of the system is consistent with an expert specialist's opinion on evaluating the performance of the system [24].

Ursula M. (2012) describe about mental health is a neglected area in health care in Ghana. With few clinicians and trained researchers in the field, research has been limited both in quantity and quality. A search of the available literature revealed 98 articles published between 1955 and 2009. The existing literature suggests several important areas for future research to inform the development of targeted and effective interventions in mental health care in Ghana [7]. Rozita Masri (2012) proposed to help the Malaysian brain research industry in diagnosing and treating their psychological patients, and furthermore to permit each psychological patient to have a few alternatives on choosing a treatment plan that accommodates their spending plan without imperiling their general medical issue. MeHDES will utilize three man-made brainpower (computer based intelligence) thinking procedures: rule-based thinking, fluffly rationale, and fluffly hereditary calculation (fuzzy GA). The human specialists' information in the region of emotional well-being and issues will be changed and encoded into an information base utilizing the standard based thinking method; fluffly rationale at that point permits the seriousness level of a specific problem to be estimated; and fluffly GA will be utilized to decide and propose the reasonable treatment for every one of the psychological patients dependent on their financial plan and their general ailments [25]. Luciano Comin Nunes; Placido Rogerio Pinheiro (2009) described psychological disorders have kept away and incapacitated professionals in different sectors of activities. The most serious problems may be associated with various types of pathologies, however, it appears, more often, as psychotic disorders, mood disorders, anxiety disorders, antisocial personality, multiple personality and addiction, causing a micro level damage to the individual and his/her family and in a macro level to the production system and the country welfare. [11]. Mobyen

Uddin Ahmed et al (2008) described about Intelligent analysis of heterogeneous data and information sources for efficient decision support presents an interesting yet challenging task in clinical environments. This is particularly the case in stress medicine where digital patient records are becoming popular which contain not only lengthy time series measurements but also unstructured textual documents expressed in form of natural languages. This paper develops a hybrid case-based reasoning system for stress diagnosis which is capable of coping with both numerical signals and textual data at the same time. Experts in the domain are very positive to our system and they deem that it will be a valuable tool to foster widespread experience reuse and transfer in the area of stress diagnosis and treatment [15]. K. Morgan C. A. Brebbia et al (2005) introduced an expert system prototype that is meant to support psychologists in finding out what disorders their clients might have. The expert system provides a user interface that permits the psychologist to enter a large variety of symptoms. The symptoms are linked to a database where records of these symptoms/symptom combinations as well as their underlying disorders are stored. The system provides fuzzy rather than deterministic feedback, i.e. Instead of suggesting only one diagnosis it indicates all possible diagnoses and estimates the risk for each possible diagnosis individually. The system is not meant to replace psychologists, but rather to support them in generating hypotheses at an early stage of diagnose [26]. Roland, Proc AMIA Annu Fall Symp. (2000) proposed a systematic and comprehensive psychiatric evaluation of mental disorders in a patient can be a rather complex and involving process. We describe an expert system, MILP, which is designed to produce such systematic diagnoses of mental disorders using selected categories from the classification and diagnostic guidelines published in DSM-III-R, DSM-IV and ICD-10. An innovative part of the MILP design is the incorporation of constraint-based reasoning as a key part of the system. We believe that the MILR design gives a flexible framework which is suitable in general for the automated diagnoses of large classes of mental disorders [19].

METHODOLOGY USED: The complete steps followed in the development of this system have been shown in figure 2.

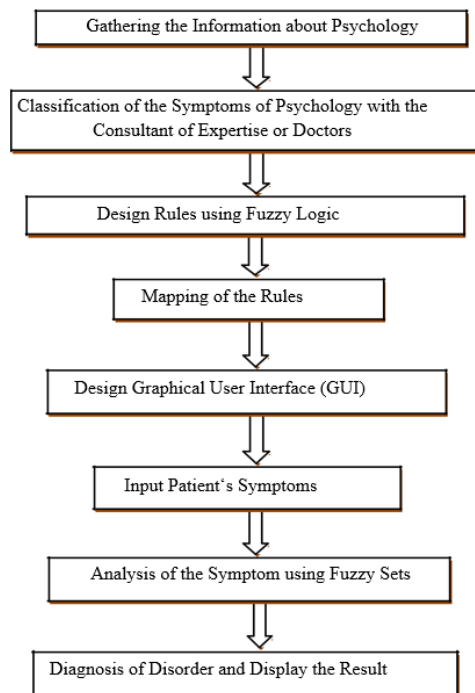


Figure 2. Flow chart of Mental illness diagnosis expert system

RESULTS AND DISCUSSIONS:

Author diagnose the results from the experience or observation and the sign and symptoms of the patient. In this study author assume about four labels: not present, mild, moderate, and severe. Place the perception takes between 0 to 10. Author consider membership function for not present-0, mild is 1-3, moderate is 4-7, and severe is 7-10. The psychological disorder is at 1st stage if the most of input symptoms in mild range(1-3), disorder at 2nd Stage if the most of inputs in moderate range(4-7) and the disorder is at final or 3rd stage if the most of symptoms in high range (7-10). We acquire the correctness of the experiments and calculation expense will be fraction of seconds. In this research, author designed an expert system for various type of psychological disorder. The existing system designed for single disease diagnosis. Diagnosis of disease is solely based on the symptoms of the disorder using Fuzzy Logic. Expert system is developed for the diagnosis of psychological disorder on the basis of symptoms of disorder. The performance of the system was analyzed by comparing the result of various type psychological disorders with the clinical report of the patients. The result of 22 patients tested by this system is presented in the following tables i.e. in table 1 and table 2.

Table 1 - Result of testing various type of Disorder by using Physical Symptoms

Variable Patient	F	MT	DB	R	DC	CP	D	S	CF	L	T	PH	System output	Results compared with clinical reports
Patient 1	2	4	3	1.5	3	0	0	0	0	0	0	0	General Anxiety disorder at stage 1	Correct
Patient 2	0	0	3	0	0	2	4	1	0	0	0	0	Panic disorder at stage 1	Correct
Patient 3	0	0	2	0	0	0	0	0	3	2	4	1	Phobia disorder at stage 1	Correct
Patient 4	7	8	6	5	0	0	0	0	0	0	0	0	General Anxiety disorder at stage 2	Correct
Patient 5	0	0	0	0	4	7	3	6	0	0	0	0	Panic disorder at stage 2	Correct
Patient 6	0	0	9	0	0	0	0	8	5	7	6	0	Phobia disorder at stage 2	Correct
Patient 7	4.5	6.5	8.5	9	4.8	0	0	0	0	0	0	0	General Anxiety disorder at stage 3	Correct
Patient 8	0	5	9	7	0	8	5.9	8.2	0	0	0	0	Panic disorder at stage 2	Correct
Patient 9	8	9	8	9	7	0	0	0	0	0	0	0	General Anxiety disorder at stage 3	Correct

Patient 10	0	0	0	1	6	4	7	3	0	0	0	0	Panic disorder at stage 2	Correct
Patient 11	0	0	9	0	0	0	0	0	5	7	6	8	Phobia disorder at stage 3	Correct
Patient 12	0	0	0	0	4.8	6.5	7	9.5	0	0	0	0	Panic disorder at stage 2	Correct
Patient 13	0	0	5	0	0	0	0	0	4	5	7	6	Phobia disorder at stage 2	Correct
Patient 14	0	0	10	0	0	10	6	7	0	0	0	0	Panic disorder at stage 2	Correct
Patient 15	0	0	0	0	0	0		3	7	9	6	0	Phobia disorder at stage 2	Correct

In table 1, F= Fatigue, MT = Muscle Tension, DB= Difficulty in Breathing, R= Restlessness, DC= Difficulty in Concentrating, CP = Chest Pain, D= Dizziness, S= Sweating, CF= Cold Flashes, L= Lightheaded, T= Tightness, PH=Pounding Heart.

Table 2- Result of testing various type of Disorder by using Emotional Symptoms

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Lack of Restraint	Y						
Delusion	Y						
Mental Confusion	Y						
Social Isolation	Y	Y			Y	Y	
Feeling detached from yourself	Y						Y
Neg. feeling about others						Y	Y
Hopeless about the future						Y	Y
Difficulty maintainng close relations						Y	Y
Try to avoid thinking						Y	Y
Avoiding places						Y	
Nightmares			Y	Y			
Fear			Y	Y			
Repetition of own words			Y				
Easily Penic			Y				
Lack of Control				Y			
Feeling depressive				Y			

grief				Y			
Feeling Shame				Y			
Self htered about eating behaviour				Y			
sadness		Y			Y		
Suicidal Ideation		Y			Y		
Feeling Guilty		Y				Y	
Slow Growth		Y				Y	
Absence of mensuration						Y	
Restless sleep		Y				Y	
Slownwss in Activity		Y				Y	
System Output	Schizophrenia disorder at stage 1	Anorexia at stage 3	OCD Disorder at stage 2	BED disorder at stage 3	OCD Disorder at stage 2	Anorexia at stage 3	Post Traumatic disorder at stage 2
Result compared with clinical reports	Correct	Correct	Correct	Correct	Correct	Correct	Correct

Here in the table OCD= Obsessive Compulsive Disorder, BED= Binge eating Disorder. Out of 22 patients 20 patients result is correct. Total patients (TP) =22, Correct Result (CR)=20, Incorrect Result(IR)=2. So overall accuracy of the system is given by Accuracy = $CR/CR+IR*100 = 20/22*100 = 91$.

CONCLUSION AND FUTURE SCOPE

In this paper, author has developed a fuzzy mental disease diagnose expert system. This system takes the input as physical and emotional symptom of the patient and diagnoses the particular disorder related to the psychology disorder. This system can be used by physician in daily practice to diagnose the disorder easily. This system allow the doctor to follow their natural process for diagnose. This system does not learn any new procedure or method of doing things. A lot of research has been done in medical field but more research is focused on to increase the accuracy of the system. So many properties of this system remain to investigate. However this expert system has some drawbacks that can be overcome in future by adding some other features. Further, in future this system can be modified to be used for diagnosing the diseases in child, disorder of the female reproduction system. Further this system can be implemented using Neuro-fuzzy method for diagnosing the chronic diseases. The developed system can also be combined with service-oriented architecture.

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