

# Fuzzy Logic Based Diagnosis System for Mental Illness

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## ABSTRACT

Mental illness is also known as mental disorder or psychiatric disorder. According to the Global Burden of Disease<sup>11</sup> mental disease will rank second as the most common cause of death after cardiovascular diseases in 2020. Early diagnosis of mental illness can be cured easily by psychiatrists. In order to help psychiatrists diagnose mental illness in an efficient and easy this study proposes a fuzzy expert system. This system considers chest pain, diarrhea, nausea, frequent cold and pain as inputs variables and stress as one output variable. The proposed system will be helpful for the psychiatrists to diagnose and cure mental illness faster and help the patient to improve his quality of life.

**Keywords:** chest pain, diarrhea, nausea, mental disorder, mental illness.

## 1. INTRODUCTION

Mental illness is also known as mental disorder or psychiatric disorder. It is a disease that affects a person's thinking, emotion, feeling, behaviour and mood and prevents the person to meet his demands and routines and relate to others. Mental disorders are related to distress and problems in family and social working places. People those who suffer from cancer, cardiovascular diseases, diabetes, etc, are easily prone to mental disorders or depression. Other disorders related to mental illness are depression, bipolar disorder, dementia, schizophrenia and anxiety disorders. As per World Health Organization (WHO), 'Depression' is a common mental disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration<sup>12</sup>. Depression not only affects the concerned person but also affects family, neighbours and friends. Early diagnosis of such disorders can help psychiatrists to help patients to get of this disease faster. In this study fuzzy expert system is proposed for the early diagnosis of mental illness.

### 1.1 Causes, Symptoms and Types of depression

Abuse, certain medications, death, conflicts, genetics, major occasions like graduating, job or marriage, social isolation and illness are few causes of depression.

Changes in mood, erratic thinking, chronic anxiety, exaggerated sense of self-worth and impulsive actions are few emotional symptoms of mental illness. Feeling sad, anxious, restless, empty, hopeless, guilty, worthless, helpless, not enjoying things you used to enjoy, suffering with concentration, memory, making decisions, thought of suicide are the major symptoms of mental illness.

The various types of depression are major depression, Persistent depressive disorder, Psychotic depression, Postpartum depression, Seasonal affective disorder (SAD) and Bipolar disorder.

## 2. RELATED WORK

Luxton, David D (2014) reviewed the development and application of artificial intelligence in the field of psychological practice. Artificial Intelligence related activities in the field of psychology are decision making, training, assistance and treatment.

Borgohain, Rajdeep, and Sugata Sanyal (2012) proposed a rule based expert system for the diagnosis of cerebral palsy. Based on the symptoms the proposed system classifies the disease as mild, moderate and severe.

Suhasini, A (2010) proposed a multi decision support system for diagnosing psychiatry related problems using Backpropagation (BP) and radial basis function (RBF) neural network models.

Yankovskaya, Anna, and Sergei Kitler (2013) designed a system for the diagnosis and prevention of mental disorders using matrix model of data and knowledge representation. Goel, Prachi, and Deepak Sharma (2014) proposed an expert system for helping the psychiatrists in the diagnosis of mood disorders.

For the diagnosis and treatment of mental disorders, artificial intelligent techniques: rule-based reasoning, fuzzy logic, and fuzzy-genetic algorithm are proposed by Usha P Kosarkar (2016).

Sumathi, M. R., and B. Poorna (2016) used dataset containing sixty records and twenty five attributes for training and testing of machine learning algorithms used for the diagnosis of mental illness. Machine learning algorithms like Multilayer Perceptron, Multiclass Classifier and LAD Tree are implemented and their performance is compared.

Hole, Komal R., and Vijay S. Gulhane (2014) designed and developed an expert system for the diagnosis of memory loss diseases namely Alzheimer's disease, Parkinson's disease, Huntington's disease, and dementia. Based on the symptoms of neurological disease the expert system rules are formed which are then used by decision tree and forward chaining algorithm.

Windriyani, Paramaresthi, *et al.* (2013) developed a computer based information system which uses forward chaining method for the diagnosis of mental disorders. Er. Sanpreet Singh (2015) proposed fuzzy expert system for the diagnosis of mental disorders like Anxiety disorder, Adjustment disorder, Impulse control disorder, Mood disorder and Neuro cognitive disorder.

### 3. PROPOSED WORK

The proposed fuzzy mamdani inference system uses input and output variables for generating rules. The system uses chest pain, diarrhea, nausea, frequent cold and pain as inputs variables to the fuzzy inference system and stress as one output variable as in fig1.

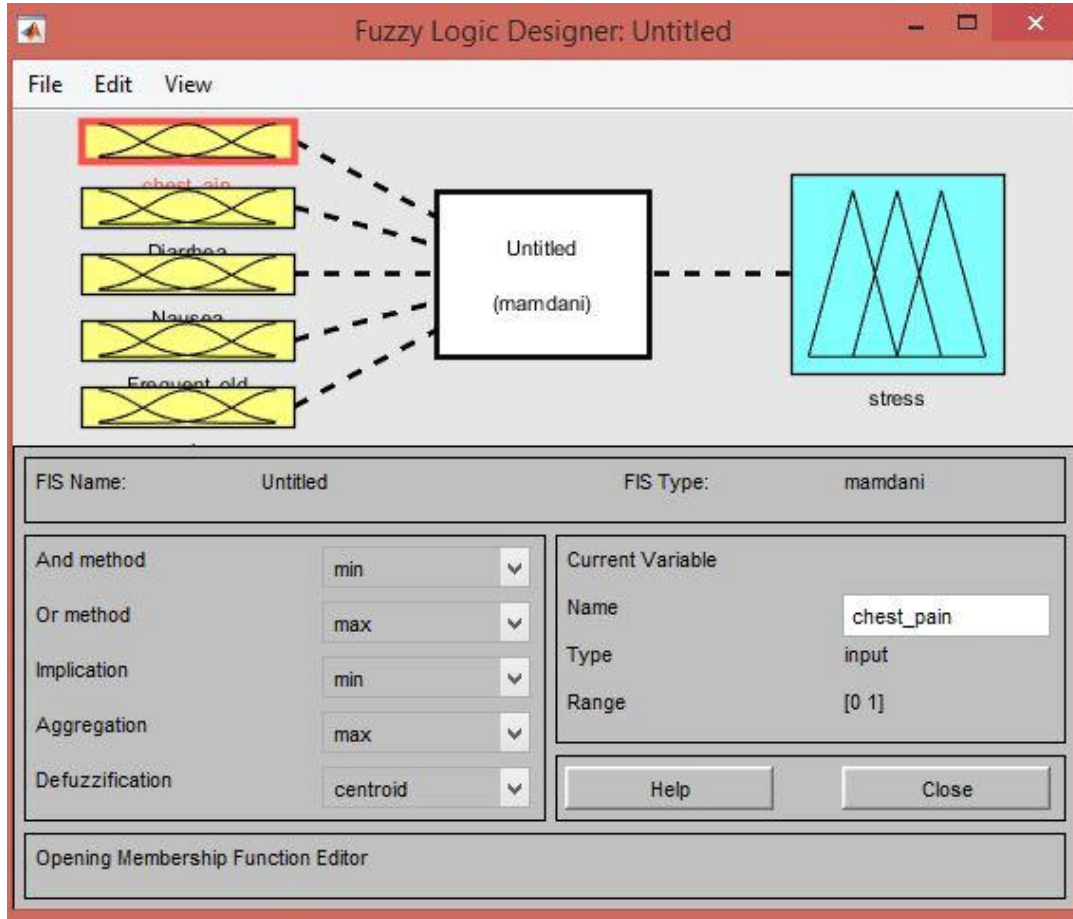


Fig1. Inputs and outputs of stress mamdani inference engine

#### 3.1 Input variables

Chest pain is first input variable and this input variable has five fuzzy sets very low, low, medium, high and very high. Membership function of these fuzzy sets is triangular. Membership functions for the fuzzy sets are given in fig 2.

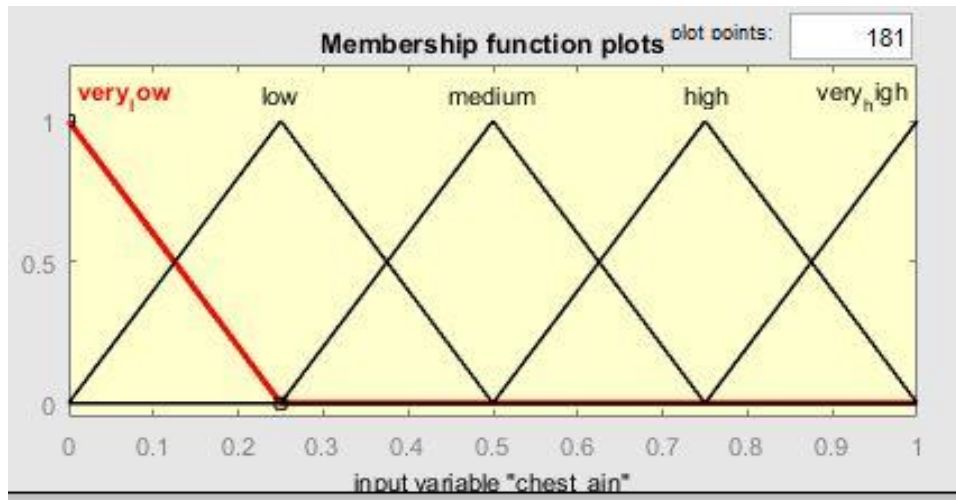


Fig 2. Membership functions of input variable- chest pain

Fuzzification of input variable chest pain is done by the below function.

$$\mu_{very\ low} = \begin{cases} \frac{x-0}{0.1-0}, & 0 \leq x \leq 0.1 \\ 1, & x = 0.1 \\ \frac{0.25-x}{0.25-1}, & 0.1 \leq x \leq 0.25 \end{cases}$$

$$\mu_{low} = \begin{cases} \frac{x-0}{0.25-0}, & 0 \leq x \leq 0.25 \\ 1, & x = 0.25 \\ \frac{0.5-x}{0.5-0.25}, & 0.25 \leq x \leq 0.5 \end{cases}$$

$$\mu_{medium} = \begin{cases} \frac{x-0.25}{0.5-0.25}, & 0.25 \leq x \leq 0.5 \\ 1, & x = 0.5 \\ \frac{0.75-x}{0.75-0.5}, & 0.5 \leq x \leq 0.75 \end{cases}$$

$$\mu_{high} = \begin{cases} \frac{x-0.5}{0.75-0.5}, & 0.5 \leq x \leq 0.75 \\ 1, & x = 0.75 \\ \frac{1-x}{1-0.75}, & 0.75 \leq x \leq 1 \end{cases}$$

$$\mu_{very\ high} = \begin{cases} \frac{x-0.75}{0.8-0.75}, & 0.75 \leq x \leq 0.8 \\ 1, & x = 0.8 \\ \frac{1-x}{1-0.8}, & 0.8 \leq x \leq 1 \end{cases}$$

Other input variables namely diarrhea, nausea, frequent cold and pain has three fuzzy sets low, medium and high. Membership function of these fuzzy sets is triangular. Membership functions for these fuzzy sets are given in fig3 and fig4.

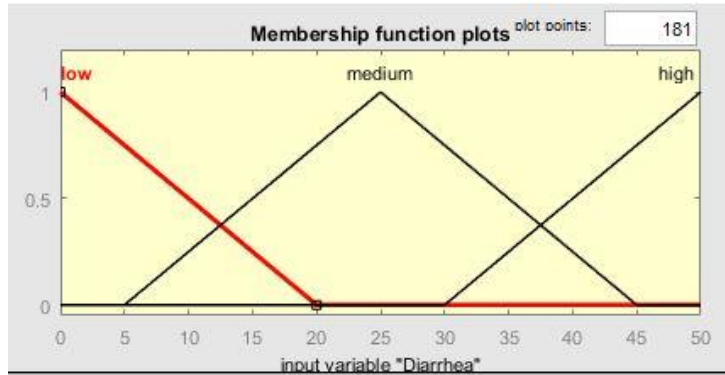


Fig 3. Membership functions of input variable-diarrhea

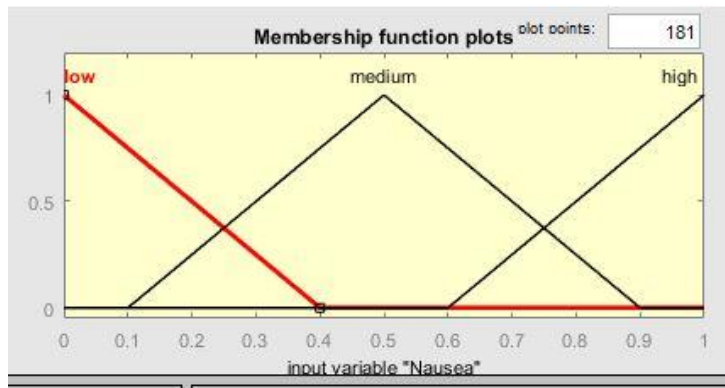


Fig 4. Membership functions of input variable- nausea

### 3.2 Output Variable

Stress is output variable and this output variable has five fuzzy sets very low, low, medium, high and very high. Membership function of these fuzzy sets is triangular. Membership functions for the fuzzy sets are given in fig 5.

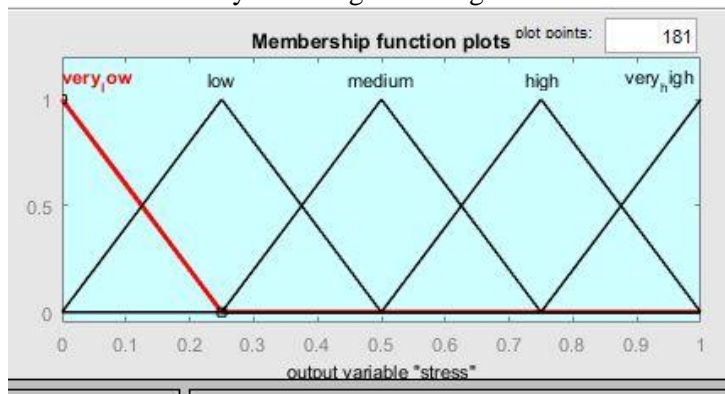


Fig 5. Membership functions of output variable- stress

#### 4. RESULTS AND DISCUSSION

Based on the input and output variable rules are generated using rule editor as shown in fig6. Rule viewer and surface viewer shown in fig7 and fig8.

1. If (chest\_pain is very\_low) and (Diarrhea is low) and (Nausea is low) and (Frequent\_cold is low) and (pain is low) then (stress is very\_low)
2. If (chest\_pain is very\_low) and (Diarrhea is medium) and (Nausea is medium) and (Frequent\_cold is medium) and (pain is low) then (stress is very\_low)
3. If (chest\_pain is very\_low) and (Diarrhea is high) and (Nausea is high) and (Frequent\_cold is medium) and (pain is low) then (stress is very\_low)
4. If (chest\_pain is low) and (Diarrhea is medium) and (Nausea is medium) and (Frequent\_cold is medium) and (pain is medium) then (stress is low)
5. If (chest\_pain is medium) and (Diarrhea is medium) and (Nausea is low) and (Frequent\_cold is medium) and (pain is medium) then (stress is low)

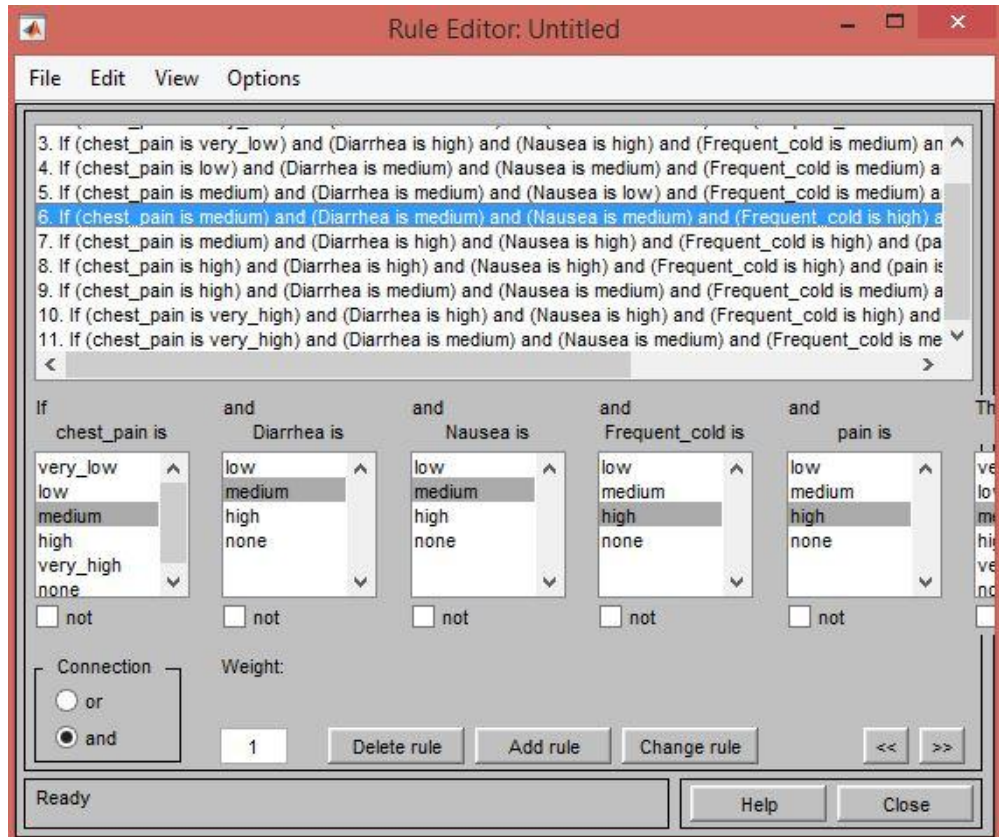
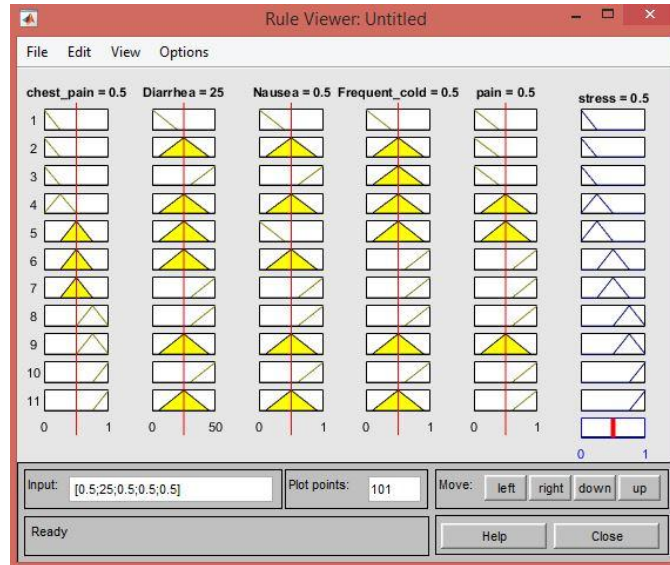
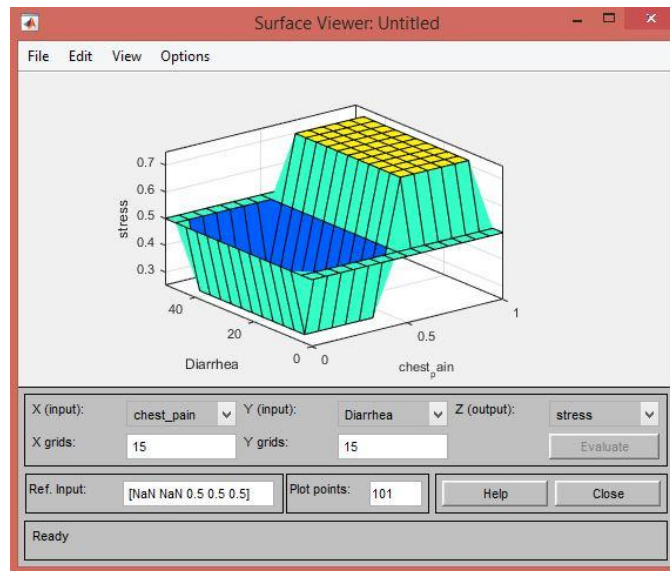


Fig 6. Rule editor



**Fig 7. Rule viewer**



**Fig 8. Surface viewer**

## 5. CONCLUSION

The proposed mamdani fuzzy inference system is very helpful in diagnosing and treating various mental illness. Early diagnosis of mental disorders assists psychiatrist to treat patients and also helps patients to improve their quality of life.

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