

An expert system on diagnosis of mental diseases

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ABSTRACT

Mental disorder is one of the most serious problems in today's time. Mental disorders can be classified into different sub-disorders according to changes in human behaviour and their mental condition. According to reports one out of seven people suffered from mental disorders. In this research paper, our main emphasis is to build an expert system that diagnoses people based on their symptoms, so people can diagnose themselves early before going to the doctor. Expert Systems are one of the most important applications in artificial intelligence that solves complex problems without human help. We provide different rules, facts, and relationships among different symptoms in our knowledge base, from which users can query their problems and get their results. We used SWI-prolog to build an expert system. There are a few types of disorders, such as mental disorders, neurodevelopmental disorders, eating disorders, etc.

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1. INTRODUCTION

Expert systems are one of the most important applications of artificial intelligence because they can solve complex problems like humans do without human intervention [1], [2]. An expert system contains a knowledge base in which various facts, rules and relationships are provided. The more complex the knowledge base, the more efficient the expert system is in solving user questions [3]–[5]. Mental disorder is one of the main problems in the world [6], [7]. According to statistics, one out of every seven people in India suffers from a mental disorder. According to different survey reports, people do not talk openly about their mental disorders [8], [9].

There are various types of mental disorders, namely eating disorders, neurodevelopmental disorders, and psychotic disorders [10]. Various in-depth studies of various disorders and their symptoms have been carried out [11]–[15]. According to the symptoms of different mental disorders, we create a knowledge base where users can ask questions, ask their problems, and get the results. To develop a rule-based expert system, we define various facts, rules and relationships in the PROLOG programming language [16], [17].

Based on research by Oguoma et al [1], artificial intelligence is used as a proposed method for diagnosing and treating mental illness in expert systems. This study states that several symptoms related to mental disorders include depression, stress, anxiety, and bipolar. The diagnosis is still limited and there are many disorders that are ignored. Previous research regarding the development of a model for diagnosing psychological disorders was also carried out by [11] using machine learning with a case-based reasoning

algorithm. This shows that the algorithm can be used for expert system development. In addition, medical methods to measure the effects of schizophrenia can also be done through the induction of pluripotent stem cells [18]. From this research, various symptoms, behaviors, and mental conditions when a person suffers from schizophrenia, as well as genetic factors associated with this disorder can be identified.

Basically, predictive data analysis was carried out by Cosic et al [19] to predict mental health disorders among healthcare workers during the coronavirus pandemic. From these studies it can be seen the effects of neurodevelopmental disorders. Subsequently, statistical calculations based on India's geological location have been carried out for mental disorders, including eating disorders, schizophrenia, bipolar, and anxiety disorders [20]. Therefore, in this paper an expert system will be developed using SWI-prolog by observing human genetic symptoms, behavior, and activity.

2. METHOD

2.1. Expert System

System Expert system consists of three parts, namely the user interface, inference engine, and knowledge base [21], [22]. The user interface acts as an interface between the user and the expert system; it takes the query in a readable format, from which the query is transferred to the inference engine. The user interface helps non-experts. They ask their questions to the interface, from where they get the results from the expert system. The main component of an expert system is the inference engine. When queries are passed from the interface to the inference engine, conclusions are drawn from the knowledge base. Users extract queries from the knowledge base using an inference engine. Knowledge base is a type of database in an expert system where it stores all the information from various facts, rules and relationships [23]. The more information stored in the knowledge base, the more accurate the expert system [24].

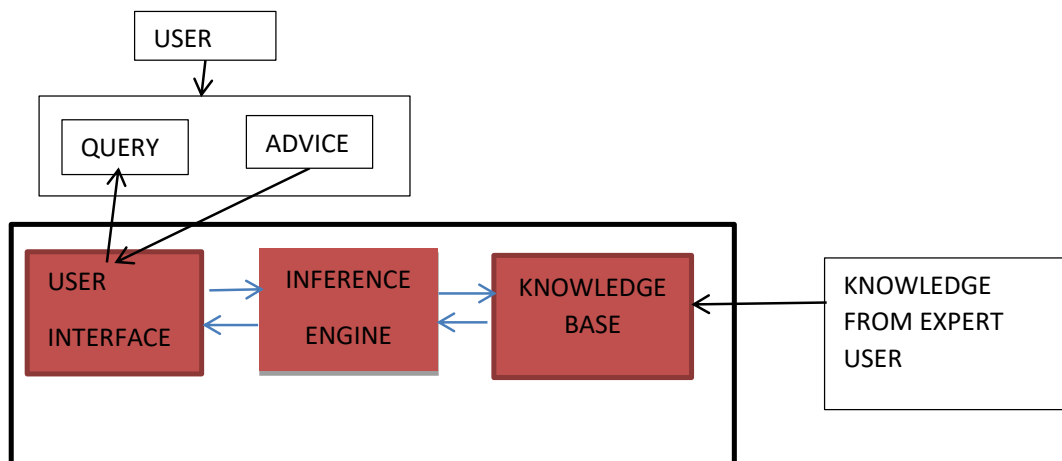


Figure 1. Architecture of Expert System [25]

2.2. Expert System Model

In the expert system model for diagnosing mental disorders as shown in Figure 2, there are several stages, including:

Initialization, this stage is the first step to start the diagnosis application by writing a diagnosis as input to be initialized. The next step, this application is designed to ask symptoms one by one and the user must answer "yes" or "no" according to the symptoms experienced by the patient. The system starts asking for symptoms of certain disorders if the user continues to answer yes (if the user actually experiences those symptoms), then the disorder is diagnosed. However, if for any symptom the user says no, the system will backtrack and start asking for new symptoms. Once the disorder is diagnosed, the process will stop.

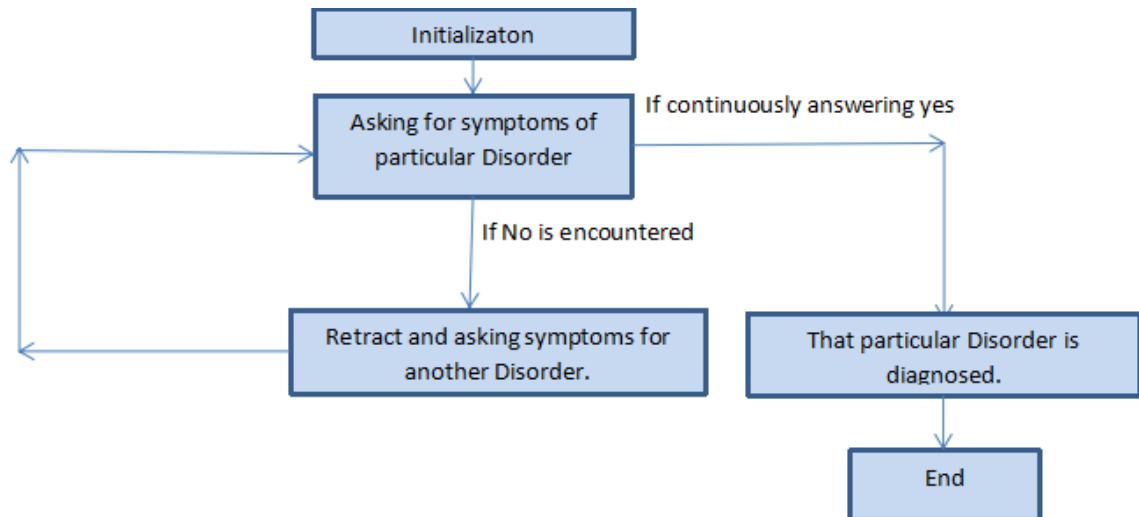


Figure 2. Model of Expert System for the diagnosis of mental disorders

2.3. Prolog Language Syntax

There are 3 Components in PROLOG namely:

- FACTS
- RULES
- QUERIES

FACTS:

Facts are declarative sentences in swi-prolog, they are usually relationship between objects. A variable is taken to be always quantified when it appears in a Prolog expression.

Examples:

```

Likes (John, Alisa).      /* John likes Alisa */
brother (X, susie).       /* X is the brother of Susie */
nationalflower(rose).    /* Rose is nationalflower*/
  
```

RULES:

Rules are those sentences that help to define the relationships between facts. It uses implication symbol (":-") to define relationships. Thus a Prolog rule came to existence.

LEFT SIDE: RIGHT_SIDE

Examples:

```

happy (Rishabh): eats (Rishabh).
/* Rishabh is happy if he eats */
son (A, B): parent (B, A), Male (A).      /* A is the son of B if B is the parent of A and A is male. */
  
```

QUERIES:

Statements that are asked by users to interface containing some variables is called a query.

Examples:

- girl? (priya).
- brother? (X, Y).
- grandfather? (a, b).

2.4. Proposed Method

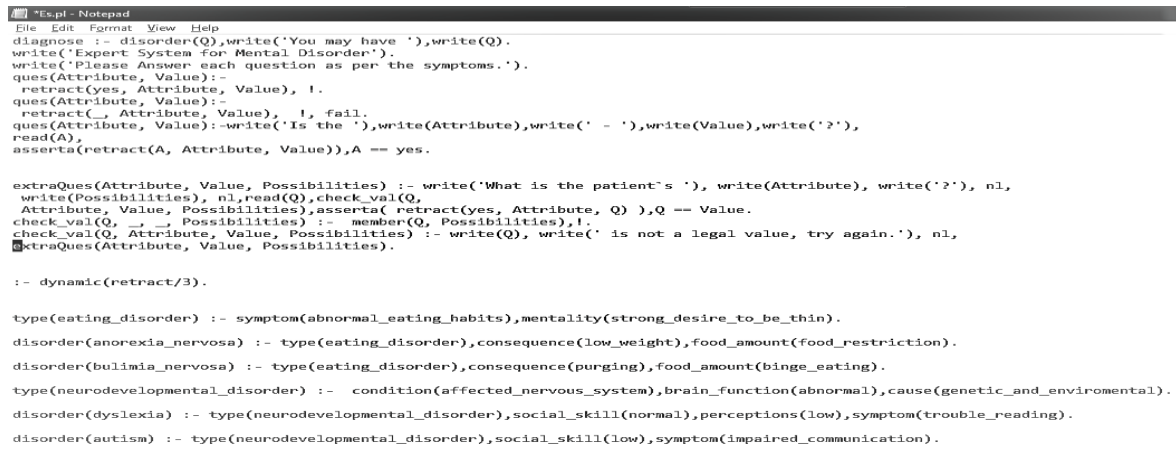
The method is applied to solve problems including procedures, measuring and analytical methods. Methods Facts and rules are as follows:

There are rules defined for questions to be asked by the expert System.

For example: ques (Attributes, Value): retract (yes, Attribute, Value), fail!.

Defining Rule for Diagnose as shown in First line in Figure 3.

Defining Rules for Type as shown in Figure 3.



```

*Es.pl - Notepad
File Edit Format View Help
diagnose :- disorder(Q),write('You may have '),write(Q).
write('Expert System for Mental Disorder').
write('Please Answer each question as per the symptoms.').
ques(Attribute, Value):-
    retract(Yes, Attribute, Value), !.
ques(Attribute, Value):-
    retract(, Attribute, Value), !, fail.
ques(Attribute, Value):-write('Is the '),write(Attribute),write(' - '),write(Value),write('?'),
    read(A),
    asserta(retract(A, Attribute, Value)),A == yes.

extraQues(Attribute, Value, Possibilities) :- write('What is the patient's '), write(Attribute), write('?'), nl,
    write(Possibilities), nl,read(Q),check_val(Q,
    Attribute, Value, Possibilities),asserta( retract(Yes, Attribute, Q) ),Q == Value.
check_val(Q, , , Possibilities) :- member(Q, Possibilities),!.
check_val(Q, Attribute, Value, Possibilities) :- write(Q), write(' is not a legal value, try again. '), nl,
    extraQues(Attribute, Value, Possibilities).

:- dynamic(retract/3).

type(eating_disorder) :- symptom(abnormal_eating_habits),mentality(strong_desire_to_be_thin).
disorder(anorexia_nervosa) :- type(eating_disorder),consequence(low_weight),food_amount(food_restriction).
disorder(bulimia_nervosa) :- type(eating_disorder),consequence(purging),food_amount(binge_eating).
type(neurodevelopmental_disorder) :- condition(affected_nervous_system),brain_function(abnormal),cause(genetic_and_enviromental).
disorder(dyslexia) :- type(neurodevelopmental_disorder),social_skill(normal),perceptions(low),symptom(trouble_reading).
disorder(autism) :- type(neurodevelopmental_disorder),social_skill(low),symptom(impaired_communication).

```

Figure 3. Editors Screenshot 1

In fig. 4 we have defined rules for Attributes such as symptom, cause, behaviour, etc.

In the last if after going through all cases if our Expert System couldn't diagnose the disorder. For that case we have defined the rule:

Diagnose: write('Cant diagnose').



```

*Es.pl - Notepad
File Edit Fgmat View Help
disorder(autism) :- type(neurodevelopmental_disorder),social_skill(low),symptom(impaired_communication).
disorder(tourettes_syndrome) :- type(neurodevelopmental_disorder),social_skill(normal),symptom(motor_tics).
type(psychotic_disorder) :- symptom(false_beliefs),mentality(manic_depressive),cause(genetic_and_enviromental).
disorder(bipolar_disorder) :- type(psychotic_disorder),indication(elevated_moods).
disorder(schizophrenia) :- type(psychotic_disorder),indication(hallucinations).
type(genetic_disorder) :- cause(abnormalities_in_genome).
disorder(down_syndrome) :- type(genetic_disorder),symptom(delayed_physical_growth),face_features(long_and_narrow),
    ears_features(large),brain_function(intellectual_disability).

food_amount(Q) :- ques(food_amount,Q).
symptom(Q) :- ques(symptom,Q).
mentality(Q) :- ques(mentality,Q).
cause(Q) :- ques(cause, Q).
indication(Q) :- ques(indication,Q).
social_skill(Q) :- ques(social_skill,Q).
condition(Q) :- ques(condition, Q).
consequence(Q) :- ques(consequence,Q).
face_features(Q) :- ques(face_features,Q).
ears_features(Q) :- ques(ears_features,Q).
brain_function(Q) :- ques(brain_function,Q).
perceptions(Q) :- ques(perceptions, Q).
behavior(Q) :- extraQues(behavior, Q, [repetitive_and_restricted, narcissistic, aggressive]).

diagnose :-
    write('Cant diagonose').

```

Figure 4. Editors Screenshot 2

3. RESULTS AND DISCUSSIONS

3.1. Classification of Mental Disorders

Based on symptoms and types, we define disorders [20] into various categories: 1) eating disorders; 2) neurodevelopmental disorders; 3) psychotic disorders; 4) genetic disorders.

1) Eating disorders

Eating disorders are a type of disorder in which people's eating habits are affected in addition to their mental and psychological behavior, resulting in troublesome [26] thoughts, and emotions. Eating disorders can be severe or mild, depending on the scenario [27].

2) Neurodevelopmental disorders

Neurodevelopmental disorders [19], [28] are disorders that affect a person's central nervous system. It affects a person's cognitive, social, and emotional functioning. This disorder usually occurs in toddlers and children [29].

3) Psychotic disorders

Psychotic disorders are a group of diseases in which a person loses the ability to think [30]. They cannot even communicate properly and face problems in handling the routines of daily life [31].

4) Genetic disorders

Genetic disorders, as the name implies, indicate abnormalities related to genes, because children inherit good genes from their parents so that sometimes due to adverse conditions mutations occur in genes that cause genetic disorders to occur [32]–[34]. Genes are made of DNA and contain characteristics that distinguish humans.

3.2. Expert System for Diagnosing Mental Disorders

Figure 5 is a working view of Diagnosing Mental Disorders. First, we type diagnostics. [to initialize the diagnosis], then we have to answer yes/not according to Symptoms.

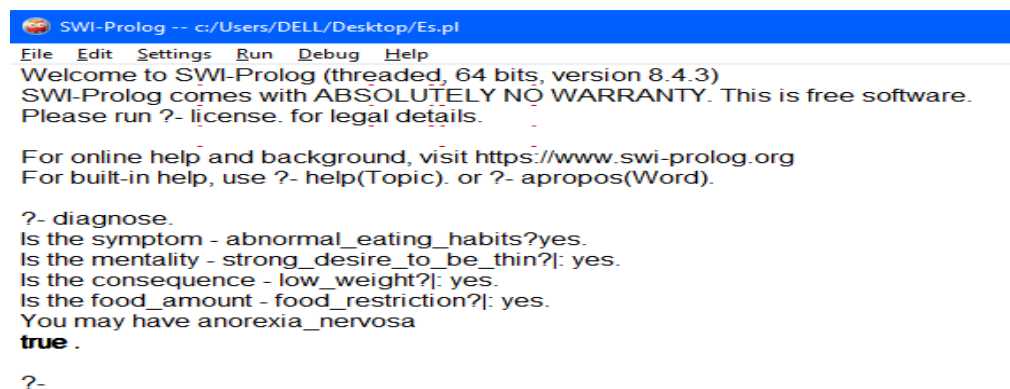


Figure 5. Prolog Expert System Interface

4. CONCLUSION

Based on the discussion that has been done, the development of a simple and easy-to-use diagnostic software for diagnosing mental disorders uses the PROLOG programming language. The system that has been created is capable of diagnosing general mental disorders in patients based on the symptoms they experience step by step in accordance with previous studies.

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