Implementation of Expert System for Medical Assistance in Disruptive Mood Disorders(ESDMD)

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ABSTRACT
In this paper 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. An Expert System can help diagnose human Disruptive Mood Disorder (DMD), assist in tracing the individual's mood and simultaneously throw light on changes in mood patterns. An Expert System with the expert knowledge base in its domain can give diagnosis of such mood disorders. 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. At the same time the Expert System would also learn various mood patterns and improvise the rules based on user data.[1]

Keywords
Mood Disorders, Expert System, DMD, DSM V, rule based reasoning, fuzzy petri nets and fuzzy genetic algorithms

1. INTRODUCTION
An expert system is a computer program that represents and reasons with knowledge of some specialist subject with a view to solving problems or giving advice. Expert systems are designed to provide "expert quality" performance on domain specific problems**.** The expert systems' is a branch of Artificial Intelligence designed to work within a particular domain. An expert is a person who has the expertise in a particular field or domain and using this as the knowledge base forms the basic block of expert system**.**[2] The source of knowledge may come from a human expert and/or from books, magazines and internet. As knowledge plays a key role in the design of expert systems, it forms an integral part of expert system. The expert's knowledge about solving the given specific problems is called knowledge domain of the expert. Using this knowledge base, inferences can be drawn and presented to the user to have an efficient living.

2. BUILDING BLOCKS OF EXPERT SYSTEMS

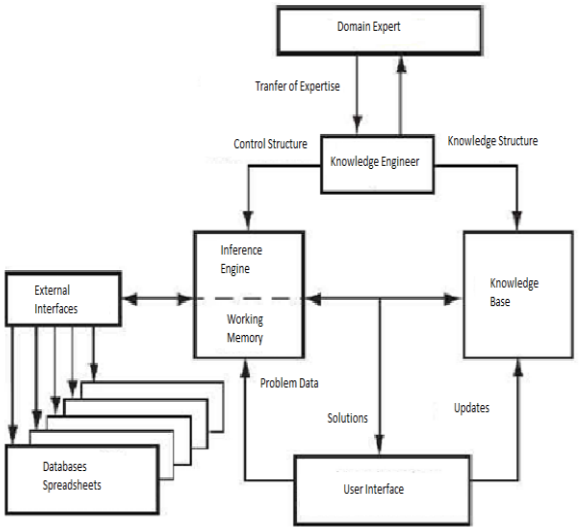

Fig 1 Detailed Expert System Architecture [3]

The fig 1 shows the detailed structure of Exert System which are having following Building Blocks:

a. The User Interface: It consists of the interaction with the knowledge user who comes for the communication with the expert system. It has following features:
   1. The user communicates with the expert system through the user interface.
   2. It allows the user to query the system, supply information and receive advice.
   3. The aims are to provide the same form of communication facilities provided by the expert.

b. Working Memory (Short Term Memory): It is the base where facts related to the problem are held and new discovered facts are generated. It consists of the following features:

   1. It contains facts about a problem that are discovered during consultation with the expert system.
   2. System matches this information with knowledge contained in the knowledge base to infer new facts.
   3. The conclusion reach will enter the working memory.
   4. Thus, working memory contain information either supplied by user or infer by the system.

c. The Knowledge Base (Long Term Memory): This knowledge database consists of all the information gathered from the knowledge expert which acts as the expertise in the expert system. It has following key features:

1. The key bottleneck in developing an expert system.
2. Contain everything necessary for understanding, formulating and solving a problem.
3. It contains facts and heuristics.

d. Inference Engine: The Inference Engine forms the heart of the expert system. The inference engine chums through countless potential paths and possibilities based on some combinations of rules, cases, models or theories. Some rules such as predicate logic mimic human reasoning and offer various mathematical arguments to any query.

While implementing the structure for its application in Mood Disorder analysis, following system architecture and building blocks were used as shown in fig 2.

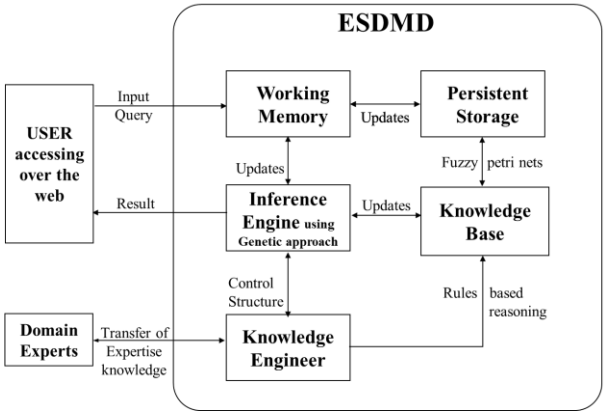

Fig 2: Building Blocks in ESDMD [1]

Here, Persistent Storage will help in keeping the records of users for the benefit of understanding the type of symptom which the user is being affected by.

3. METHODOLOGY[1]

After understanding the various mood disorders and their symptoms ,following steps can be used to

Step 1: Users register and create account on the working memory which keeps storing the updated profiles of the users in persistent storage. At the same time domain experts also authenticate and transfer of expertise to the knowledge engineer.

Step 2: Through the knowledge engineer, expertise data is put into the knowledge base with the help of Rule Based Reasoning. For example, to fill the expert data for the particular mood disorder Unipolar with the required symptoms, states and reasoning associated with them, the structure will look like following:

Disorder	Symtoms	States	Reasons
UNIPOLAR	Mood	M1, M2, M3…	Rm1, Rm2, Rm3…
	Sleep	S1, S2, S3…	Rs1, Rs2, Rs3…
	Interest	I1, I2, I3…	Ri1, Ri2, Rm3…
	Guilt	G1, G2, G3…	Rg1, Rg2, Rg3…
	Energy	E1, E2, E3…	Re1, Re2, Re3…
	Concentration	C1, C2, C3…	Rc1, Rc2, Rc3…

Rule 1: if <M1/ M2/ M3…> AND <S1/ S2/ S3…> AND <I1/ I2/ I3…> AND <G1/ G2/ G3…> AND <E1/ E2/ E3…> then UNIPOLAR <U1>

Rule 2: if <M1/ M2/ M3…> AND <S1/ S2/ S3…> AND <I1/ I2/ I3…> AND <G1/ G2/ G3…> AND <C1/ C2/ C3…> then UNIPOLAR <U2>

and so on

Fig 3: Rule Based Knowledge Base

The above rule will match the user with the corresponding disorder type depending on the level of screening chosen and the input data provided.[28]

Step 3: Knowledge engineer also provides with the control structure to the inference engine for the analysis of the screening, and the inference to be derived for the users.

Step 4: Persistent Storage will be updated with user profile and the knowledge base will respond with the fuzzy petri nets approach to match the symptoms and be responsive to the working memory. Following shows an example of the "hit" matching with the user specified reasoning:

Expert Knowledge Base

Disorder Symptom	Threshold	Meaning	Reasons
MOOD	**-2**	Depressed every day	R1m-2, R2m-2, R3m-2…
	-1	Once or twice a week	R1m-1, **R2m-1**, R3m-1…
	0	Not at all	R1m0, R2m0, R3m0…
	1	Not in 2 weeks	R1m1, R2m1, R3m1…
	2	Not in a month	R1m2, R2m2, R3m2…

Hit

User Inputs – historical records

Screening Criteria	Threshold	Meaning	Reasons
MOOD	-2	Depressed every day	R1m-4, R2m-1, R3m-1…
	-1	Once or twice a week	R1m-2, **R2m-1**, R3m2…
	0	Not at all	R1m-2, R2m-2, R3m-2…
	1	Not in 2 weeks	R1m-2, R2m-2, R3m-2…
	2	Not in a month	R2m2, R2m-2, R3m1…

Fig 4: Database Fuzzy Threshold for Persistant Storage

The threshold will be useful to measure the states of the symptoms to give better understanding of the reasons being matched with the expert data and user data.

Step 5: Evaluation of the mood disorder type will be done with the help of genetic approach to account for the number of times the "hits" are obtained for the reasoning module. This will be initiated depending on the duration of the screening and the user profile being updated. For example, the mood status to be depressed for a particular event in time will not account for mood of the user as a whole but a standard deviation would help suggest the range and inference could then be derived.

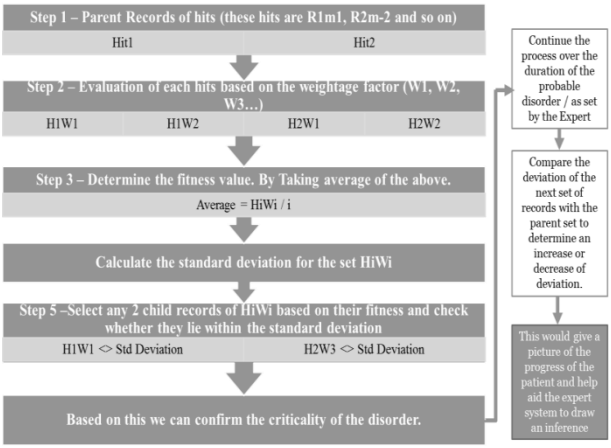

Fig 5: Genetic Approach for Evaluation

4. METHODOLOGY[1]

1. Interface design module: This module will support the creation of accounts to various users who will login into the system. They will include the patient and their family members along with the expert who are needed to lend help at the time of adversity.
2. Data collection: In this phase the knowledge from the expert has been created to define the rules and subdividing the types of disorders into a decision tree.
3. Data creation and Persistent Storage: This module will prepare the data into defining as per the required type of mood disorder and classifying the data as per the user login.
4. Classification and Feature extraction: This module will keep track of the behavior patterns as per the daily records input by the user. It will synthesize the data which will be closest to the particular type of disorder. Along with this feedback of the mood behavior shown by the individual will be considered to match other requirements.
5. Evaluation: This module will evaluate the user based on the graphs as the output patterns of mood behavior and highlight the percentage of closeness with respect to particular mood disorder

5. DATA FLOW DESIGN DIAGRAMS

Following are the data flow diagrams with respect to

ESDMD. Fig 5 explains the Level 0 data flow diagram.

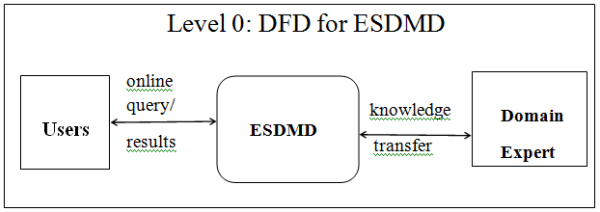

Fig 6 Level 0 Data Flow Diagram for ESDMD

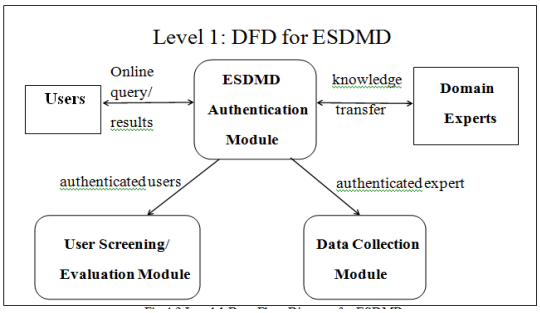

Fig 7 Level 1 Data Flow Diagram for ESDMD

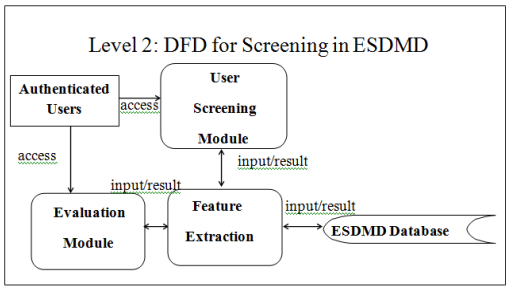

Fig 8 Level 2 Data Flow Diagram for ESDMD

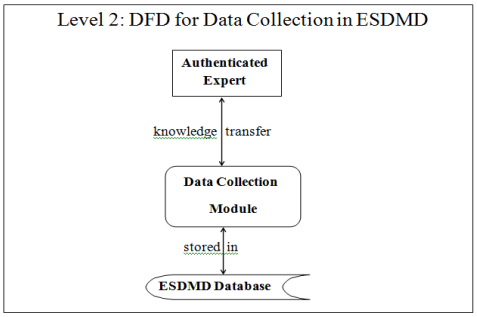

Fig 9 Level 2 Data Flow Diagram for Data Collection in ESDMD

6. IMPLEMENTATION DETAILS

Following are the screenshots after implementing the modules specified in research work for ESDMD.

3.1 Steps in implementing the Interface Module

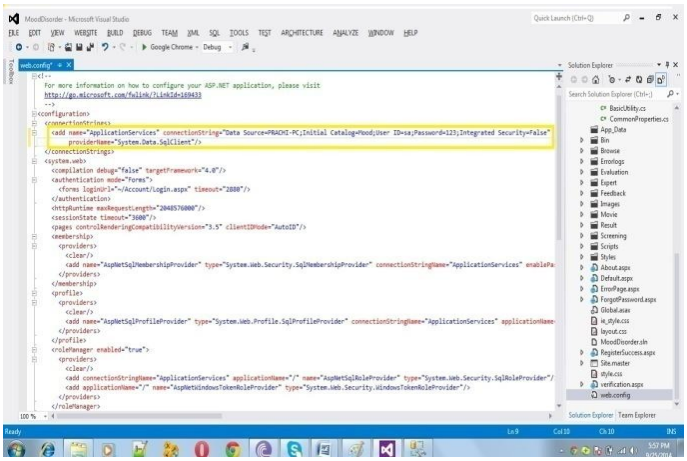

Fig 10 Implementing Interfacing with SQK 208 r2 with Visual Studio 2012

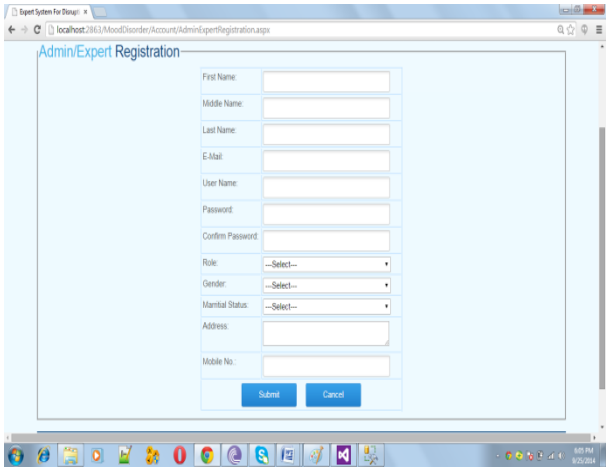

Fig 11 Registration of the Knowledge Engineer

Fig 12 Home Page for ESDMD

Fig 13 Knowledge Engineer Panel of Options

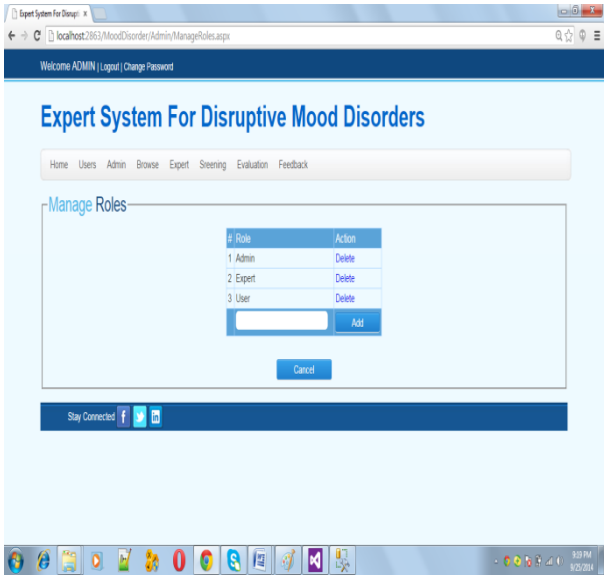

Fig 14 Managing the Roles in ESDMD

Fig 15 Managing Screening Options

3.2 Steps in implementing the Data Collection Module

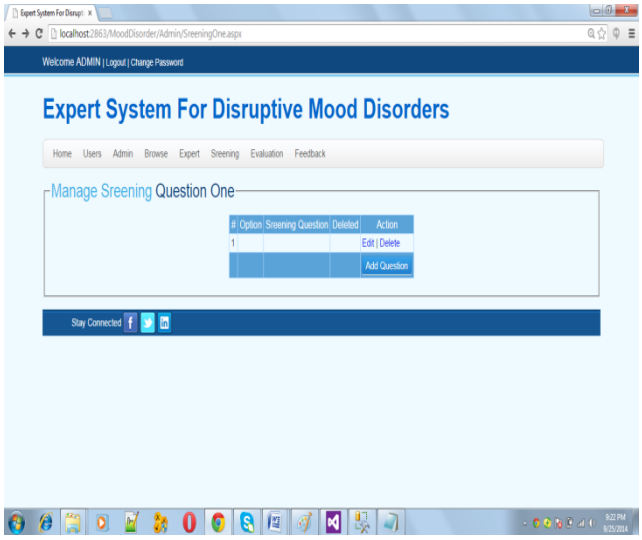

Fig 16 Data Collection in ESDMD

3.3 Steps in implementing the User Registration Module

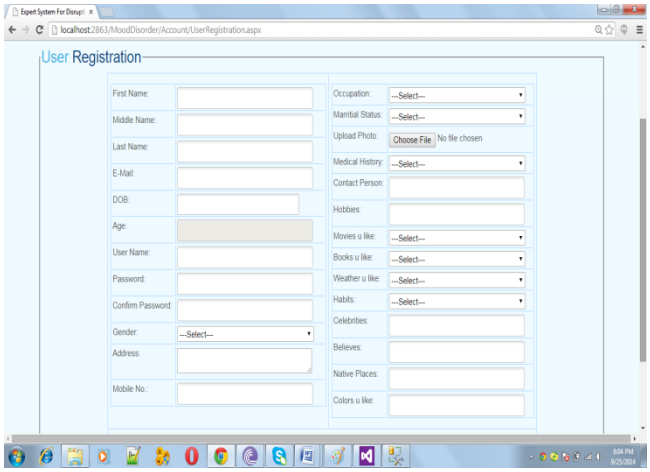

Fig 17 User Registration

3.4 Steps in implementing the Data Preparation Module

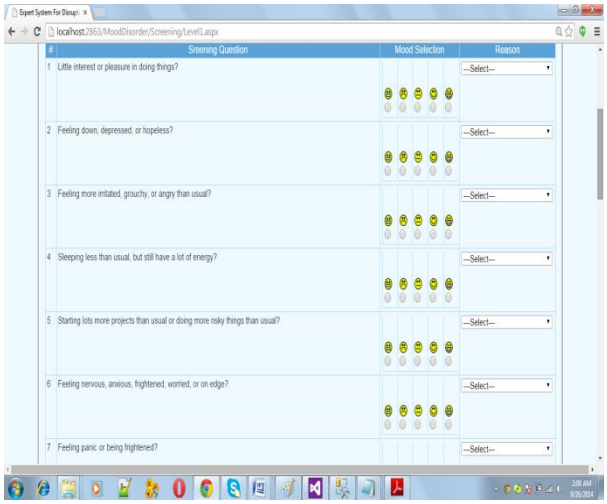

Fig 18 Screening Questions

3.5 Steps in implementing the Feature Extraction Module

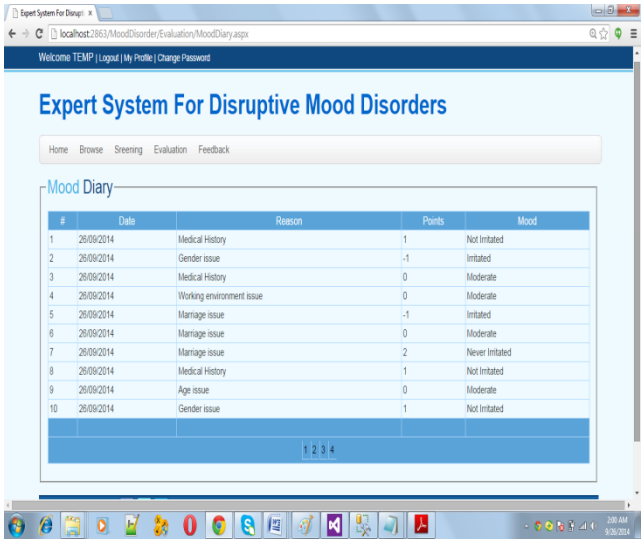

Fig 19 Feature Extraction in ESDMD

3.5 Steps in implementing the Evaluation Module

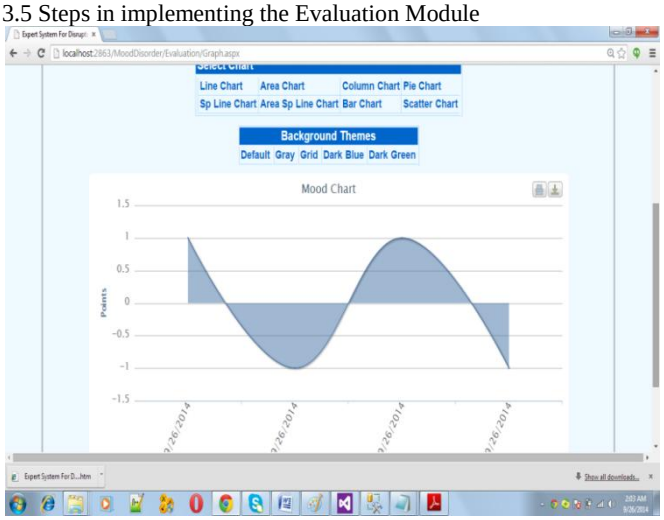

Fig 20 Evaluation Module

7. CONCLUSION

Implementation and evaluation of ESDMD brings about many positive effects with respect to analyzing oneself and knowing the varied mood symptoms in a person. Through the options provided to the user and expert, it can facilitate the users in understanding the particular reasoning which according to the expert would be appropriate. Hence in situations of turmoil and not able to understand mood can be aided with such system.

The success to aid mood disorders begins with accurate diagnosis. This diagnosis can be more relevant with the proper participation from the individual. Therefore creating an alarm to help monitor the result and get the feedback would be an addition to the features. Further, the next step involves building a mechanism to treat the patients with the aid of experts so as to keep observing in the changing patterns of mood behavior which changes frequently and fast.There are systems being developed with the aid of using sensors which can aid this issue but due to hardware involved, these systems can be not highly dependent. The future scope of the application ESDMD also includes addition of healing facilities being provided in the form of medication and meditation which can enhance the person outlook to take care of the mind as well.

8. ACKNOWLEDGMENTS

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