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Behavioral Pattern Based Psychotic Analysis for Improved Student Performance using Fuzzy Set

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Abstract: ***The problem of bipolar disorder has been well studied and analyzed. To perform the detection of presence of BD, there are number of approaches available and the result of detection has been used in several ways. In order to improve the performance in BD detection and utilize the result in gauging the performance of students, a behavioral pattern base psychotic analysis model has been presented in this paper. The method maintains the behaviors, habits and interests of different students in different period of time. The student behaviors includes mood change, depression, sudden laughs, uninterested, short temper, lack of concentration, adamant, frustration, energy, sleep and so on. Such behaviors has been tracked for number of students for prolong period and stored in the behavior set. By reading the behavior set and with the identified samples of BD, the method generates set of behavioral patterns. The behavioral pattern has been generated for three different classes like lower, medium and high. For each class of behavioral pattern, the method generates set of fuzzy rules. Using the fuzzy rule, each student has been analyzed for their behavioral pattern in different time window. Based on the patterns, the method estimates BDCW (Bipolar Disorder Class Weight). Based on the weight measure, the presence of BD has been identified and classified under different class. Identified results have been used to generate academic pattern and helps to generate analysis result to improve the student performance. The proposed approach improve the performance of student development, monitoring and health development.***

Keywords: ***Bipolar Disorder, Manic, Depressive Episode, Psychotic Analysis, Behavioral pattern, Fuzzy Rules, BDCW.***

I. INTRODUCTION

The growth of information technology has supported different domains in such a way to develop concern sector. The educational institutions have the requirement of adapting various factors in the monitoring and development of students. In particular, the primary and secondary students should be focused for their performance in education as well as extracurricular activities. In reality, the performance of a student not only depends on his own but also has other factors which influence his performance. In that way, the presence of certain chronic diseases would struggle him to perform well. The bipolar disorder (BD) is the disease which occurs in the child hood and affects the performance of a student. The presence of BD in any adult can be identified by various activities like short temper, lack of concentration, missing presence, sudden laugh, adamant, depression, change in mood, energy, sleep and so on. For example, a student would laugh suddenly without any reason which can be identified as BD. Similarly, he would be having different mood and energy and sleep than normal kids. All these factors can be used to detect the presence of bipolar disorder.

Let us discuss what the research is about and where you can use. The presence of BD in adults has been detected using different methods. However, the detection in early stage would help to improve the performance of a student. By providing counseling to the student, and by providing motivation to the staffs of the school in handling the student, the performance can be improved. But the prediction of BD is the most important factor which should be performed at the earliest so that you can take advice from the medical practitioner. It cannot be performed instantly and the student should be monitored for number of months and based on that logs you can perform the BD detection. To perform this, there are number of approaches available like K means clustering. But they only consider the specific features and leave the rest.

To improve the performance, this paper present behavioral pattern based BD detection and psychotic analysis which uses fuzzy rule sets. The proposed method intended to include the features of both mania episode and depressive episode. The student has been monitored for his behavior throughout the year in different time window. Also, the performance of the student in different window has been monitored. By maintaining the logs of both behavioral and academic features, the presence of BD has been analyzed. By maintaining the logs of both behavior and academic features, you can generate number of patterns. Similarly, the method can maintain number of patterns towards various class of BD, which is generated from the learned and classified data. The generated patterns can be used to generate fuzzy rules for various class and can be used to measure the Bipolar Disorder class weight (BDCW) to perform detection. Once, it has been detected, the academic pattern can be generated to measure the performance. By analyzing both the patterns of student, the development process can be monitored towards student performance development. The detailed implementation has been discussed in the next section.

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II. RELATED WORKS

There are number of methods available for the problem of BD detection and performance analysis of student group. This section discusses few methods related to the problem.

In [1], the author present a pattern based technique to find the presence of BD. The method considers the persistence of any pattern to produce the result. In [2], the author present a BD detection scheme which considers the mood disorders in multi-family psycho education groups (MFPG).

In [3], the author present a guideline for the diagnosis and treatment of BD in pediatric. They present the guideline with comorbidity, treatment, maintenance and diagnosis. In [4], the author presents a solution for the detection of BD at early stage. They also provide a solution for treatment and medications. The treatment of EOBSD is analyzed and reviewed in detail. In [5], the author propose a predictor model which works based on quad-phased data mining for the diagnosis of BD.

In EmHealth [6], the author designed a application runs on mobile which is capable of collect the emotional information of various users. It monitors the change in mood. It detect the presence of BD using fluctuating change in mood. In [7], the author proposes an apriori based prediction model. Using the logs of various depressive patients the method applies apriori algorithm to perform predicting BD.

In [8], the author present a stress level based Multi-level assessment model. The sensors are used to collect the behaviors of users. Set of rules are generated using the data collected and support the detection of BD. In [9], the data mining techniques are used for the detection of BD and its symptoms. The frequent pattern techniques are used to find the symptoms.

In [10], the author presents a book classifier for the prediction of BD. The Bayesian classifier is used for the classification. Similarly in [11], the author present a multi stage prediction algorithm using real data set.

In [12], the author present sensor based depression detection algorithm with the chronic disorder patients. In [13], the author present schizophrenia prediction algorithm which analyses the problem using decision tree. In [14], the author presents a ultra-short term HRV analysis scheme to detect the mental stress using academic questions. In [15], a genetic algorithm based diagnosis approach is presented.

In [16], an online depression detection scheme is presented which uses topic and linguistic analysis. The method uses the conversations on social network to perform detection. In [17], the same techniques are used for the detection of suicide using the topical analysis.

All the methods suffer to achieve higher performance in BD detection and performance analysis.

III. BEHAVIORAL PATTERN BASED PSYCHOTIC ANALYSIS MODEL USING FUZZY RULES

The behavioral pattern based psychotic analysis model maintains the log of various students belongs to different time window. Using the logs, the method generates number of behavioral pattern for different class of bipolar disorder. For any student, the method generates the behavior pattern and measure the bipolar feature similarity (BFS) towards each class. Using the BFS value measured, the method computes the bipolar disorder class weight (BDCW) towards each class. Similarly, the method estimates the student performance pattern using the logs of various students.

Using the student performance pattern the method measures performance similarity measure (PSM) to grade the student. The detailed approach is presented in this section.

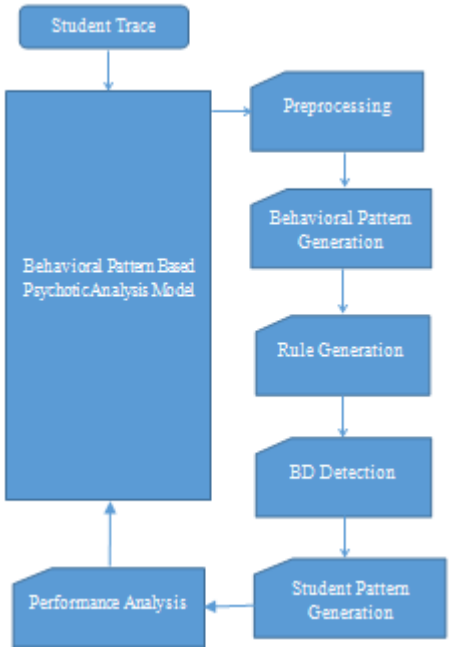

Fig. 1. General Block Diagram of BPPAM model.

The architecture of proposed behavior pattern based psychotic analysis approach is presented in Figure 1.

A. Preprocessing

The logs of student is already classified and grouped under different level of bipolar disease. In this stage, the method first read the logs available in each class of bipolar disease. Then the list of features available in the trace has been identified. Using the feature list identified, the method verifies the availability of feature and value for all the features present in the feature list. If any of the trace identified as incomplete or having missing values, then the method eliminates the trace to continue BD detection and analysis.

Preprocessing Algorithm

Input: Cluster Set Cs
Output: Cluster Set Cs.
Start
Read cluster set Cs
Initialize feature list Fl.
For each cluster c
For each sample s
If $\int_{i=1}^{size(s)} Fl \cup (s(i) \ni Fl)$
End
End
For each cluster c
For each sample s
If s $\in$ $\forall\ feature \in Fl$ then

C = $\sum(samples \in C) \cap s$
End
End
End
Stop

The working principle of preprocessing algorithm is presented above which reads the traces from each group of BD and finds the list of features and eliminates the records which has missing values.

B. Behavioral Pattern Generation

In this stage, the method reads the samples present in each BD class. From the samples read, the method extract the features like short temper, lack of concentration, missing presence, sudden laugh, adamant, depression, change in mood, energy, sleep. Using the features extracted and the values, the method generates the pattern for each sample. Generated pattern set has been used to generate the fuzzy rules to support BD detection.

BP Generation Algorithm:
Input: BD Class Trace Bct
Output: BP Set bps
Start
Read bipolar disease class trace Bct.
Initialize behavioral pattern set Bps.
For each trace t
Extract short temper Stemp = $\int_{i=1}^{size(T)} ShortTemp \in T$
Extract Concentration Lack Clack = $\int_{i=1}^{size(T)} CLack \in T$
Extract Presence of mind Pmind = $\int_{i=1}^{size(T)} Pmind \in T$
Extract Sudden Laugh Slaugh = $\int_{i=1}^{size(T)} SLaugh \in T$
Extract adamant Admt = $\int_{i=1}^{size(T)} Adamant \in T$
Extract depression Dip = $\int_{i=1}^{size(T)} Depression \in T$
Extract mood in change Cmood = $\int_{i=1}^{size(T)} MoodChange \in T$
Extract energy Penergy = $\int_{i=1}^{size(T)} Energy \in T$
Extract sleep Psleep = $\int_{i=1}^{size(T)} Sleep \in T$
Generate pattern p= {Stemp, Clack, Pmind, Slaugh, Admt,Dip, Cmood, Penergy, Psleep}
Add to pattern set Bps = $\sum(Pattern \in Bps) \cup p$
End
Stop

The behavioral pattern generation procedure generates the behavior pattern for specific class of disease considered. Generated pattern set has been used to perform bipolar disorder disease detection.

C. Rule Generation

The fuzzy rule performs vital role in the detection/prediction of bipolar disorder diseases. To generate the rule for different BD classes, the method generates the pattern set for the BD class. Using the pattern set generated, the method computes the minimum and maximum values for each feature present in the pattern set. Using the minimum and maximum values of different features, the method generates rule for the specific class. Generated rules are used to perform BD detection.

Algorithm:
Input: Cluster C
Output: Rule set Rs
Read cluster C.
Behavioral Pattern set Bps = Generate Behavioral pattern set ©
Identify list of features Flis = $\sum Features \in \forall patterns(Bps)$
Initialize fuzzy rule Fr = $\int_{i=1}^{size(Flis)} Flis(i).min = 0 \;\&\&\; Flis(i).max = 0$
For each feature f
Compute minimum value Fmin = $\int_{i=1}^{size(Bps)} Min(Bps(f))$
Compute maximum value Fmax = $\int_{i=1}^{size(Bps)} Max(Bps(f))$
Fr(f).min = Fmin
Fr(f).max = Fmax
End
Stop

The working principle of rule generation algorithm estimates the feature minimum and maximum values on all the features present in the pattern set. Using the value measured, the fuzzy rule has been generated.

D. Bipolar Disorder Detection

The presence of bipolar disorder has been detected for any student according to the patterns generated for different BD classes. For each class of BD, the method generates the pattern set and generates the fuzzy rules. Using the input sample, the method estimates the bipolar feature similarity (BFS) towards various patterns of each class which has been binarized. Similarly, with the fuzzy rules of the class, the method estimates the bipolar disorder class weight (BDCW). Based on the value of BDCW, the method identifies the class of student or input sample.

Algorithm:
Input: Test sample Ts, Cluster set Cs
Output: Class C
Start
Read test sample Ts and cluster set Cs
For each cluster or class c
Bps = generate behavioral pattern set ©
Fuzzy rule Fr = Generate fuzzy rule (Bps)
For each pattern pi
Binary pattern Bp = Binarize(pi)
Estimate Bipolar Feature similarity BFs.
BFS = $\frac{\int_{i=1}^{size(Bp)} \sum Bp(i)==Ts(i)}{size(Bp)}$
Compute Bipolar Valued similarity Bvs.
BvS = $\frac{\int_{i=1}^{size(Fr)} \sum Ts(i)<>Fr(i)}{size(Fr)}$
End
Compute BDCW = $\frac{\sum BFS}{size(Bps)} \times \frac{\sum Bvs}{size(Bps)}$
End

Class C = Choose the class with maximum BDCW.
Stop

The bipolar disorder detection algorithm measures both bipolar feature and value similarity towards various class of bipolar disorder. Based on the value measured, the method compute the bipolar disease class weight towards different classes. Finally a class with maximum BDCW value has been selected as result.

E. Student Pattern Generation and Analysis

The performance of the student at different time window has been measured according to the student performance pattern generated. It has been generated based on the features like marks scored, questions answered, questions asked, no of sessions participated, and so on. Using the features mentioned, the method generates the performance pattern for different class. Similarly, the method estimates the performance feature similarity (PFS) with the patterns available for different class. Based on the PFS value, the class of student has been identified.

Algorithm:

Input: Student Current Sample scs, Academic Performance Trace Apt.

Output: class C

Start

Read Apt and Scs.

For each class c

Identify the logs related to c as

$$\text{Cset} = \int_{i=1}^{size(Apt)} \sum Apt(i).class = c$$

Generate performance pattern

Pps = Pattern Generation (Cset).

For each pattern p

Compute performance feature similarity

$$\text{Pfs} = \frac{\int_{i=1}^{size(p)} \sum P(i) == Scs(i)}{size(p)}$$

End

Compute cumulative PFS = $\frac{\sum_{i=1}^{size(pps)} Pfs}{size(pps)}$

End

Class c = choose the class with maximum Pfs.

Stop

The above discussed algorithm estimates the performance feature similarity towards various class of performance according to the academic performance patterns. Based on the value of PFS a single class has been selected which mention the rate of performance of the student which has been used to analyze the status and performance of the user..

IV. RESULTS AND DISCUSSION

The proposed behavioral pattern based psychotic analysis model with fuzzy system is hard coded using java. The BPPAM algorithm is measured for the performance in different factors.

Table 1: Details of Evaluation

Parameter	Value
Disease classes	Normal, Low, Medium, High
Student Performance Class	Low, Medium, High
Number of users	1000
Number of logs	1 million
Tool Used	Advanced Java

The evaluation details considered for the performance measure of proposed BPPAM algorithm is presented in Table 1.

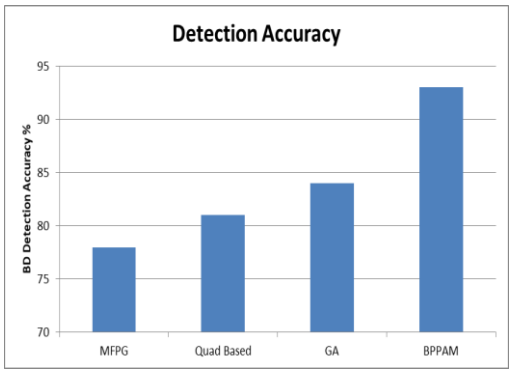

Fig. 2. Performance on Bipolar Disorder Detection Accuracy

The performance in Bipolar Disorder detection produced by BPPAM algorithm is presented in Figure 2. The proposed BPPAM algorithm achieved noticeable performance.

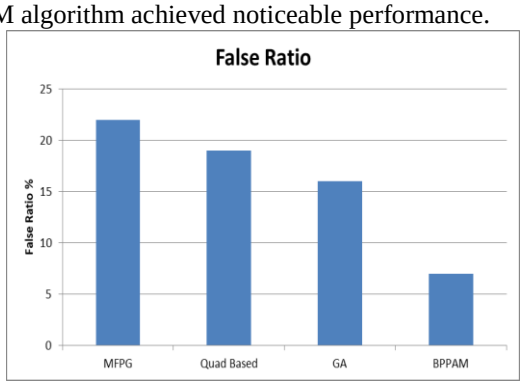

Fig. 3. Performance on false ratio

The performance on false ratio in BD detection is computed and it has reduced the ratio of false classification.

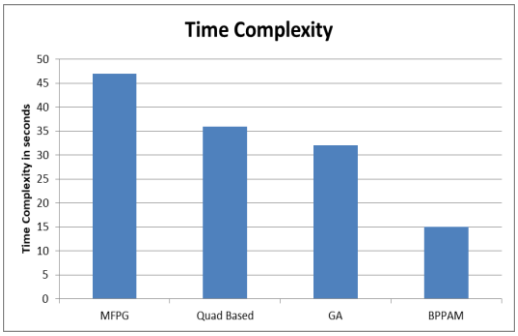

Fig. 4. Performance on time complexity

The time complexity of BD detection is measured and the proposed BPPAM algorithm reduced the time complexity.

V. CONCLUSION

In this paper, an efficient behavioral pattern based psychotic analysis has been presented which uses fuzzy rule sets. The method generates behavioral pattern towards various disease class and for each of them the method estimates the bipolar disorder class weight for the input sample. Based on the value of BDCW, the method selects a class.

Similarly, the method estimates the performance features similarity towards the performance pattern generated using the student performance log. Based on the performance feature similarity value, a single performance class has been selected. The proposed method improves the performance of BD detection accuracy and reduces the time complexity. Also, the method generates support to the performance development of students.

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