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Exploration of Autistic Children using Case Based Reasoning System with Cognitive Map

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***Abstract*—**Exploring an autistic child in Elementary school is a difficult task that must be fully thought out and the teachers should be aware of the many challenges they face raising their child especially the behavioral problems of autistic children. Hence there arises a need for developing Artificial intelligence (AI) Contemporary Techniques to help diagnosis to discover autistic people.

In this research, we suggest designing architecture of expert system that combine Cognitive Maps (CM) with Case Based Reasoning technique (CBR) in order to reduce time and costs of traditional diagnosis process for the early detection to discover autistic children. The teacher is supposed to enter child's information for analyzing by CM module. Then, the reasoning processor would translate the output into a case to be solved a current problem by CBR module. We will implement a prototype for the model as a proof of concept using java and MYSQL.

This will be provided a new hybrid approach that will achieve new synergies and improve problem solving capabilities in AI. And we will predict that will reduce time, costs, the number of human errors and make expertise available to more people who want who want to serve autistic children and their families.

***Keywords*—**Autism, Cognitive Maps (CM), Case Based Reasoning technique (CBR).

I. Introduction

AUTISM is a Social development disorder that is marked by a distinct lack of social and language skills. It is a disorder rather than an organic disease and hence is difficult to diagnose without a diagnostic team consisting of experts in the field of medicine and psychology. In Saudi Arabia, most autistic children attend Elementary schools for several reasons, including the lack of awareness about this disorder, limited resource and infrastructure available for these Special children.

An interesting point that characterized children with autism is that they are unable to choose which event is more or less important. They cannot be easily diagnosed and discerned due to its similar characteristics to other normal children. So the teachers need to know who has autism disorder from their students to categorize the students into a suitable curriculum activity based on diagnostic psychology decision.

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Recently, Scientists works for supporting the idea that computer science can be used to help their .we can tackle this problem by using Artificial intelligence (AI) Contemporary Techniques to cooperate with the teacher in accomplishing solving problem task in our study. AI techniques such as Case Based Reasoning (CBR) has been successfully integrated with other techniques or with other software system components depending on the application needs [1].Cognitive Maps (CM) is widely used in much different application of AI domains, as a means for constructing organizational memory, and it is more superior to common knowledge representation scheme such as rule and frame [2]. The combination of (two or more) different problem solving and knowledge representation methods is a very active research area in AI.

Therefore the main goal of our study is designing architecture of Expert System that combine Cognitive Maps with Case Based Reasoning method in order to reduce time and costs of traditional diagnosis process for the early detection to discover autistic children in Elementary school. We will predict that this hybrid approach will reduce time, costs and the number of human errors of traditional diagnosis process for such children so we will focus their educational skills on the symptoms that appear to them in their classroom to help such children to overcome the barriers they face in their classes.

In this proposed research, we suggest designing architecture of expert system. The teacher should not be aware of any diagnostic criteria for diagnosing autism which are entirely behavioral such as Autism Rating Scale. He/she is supposed to enter child's information for analyzing by CM module. Then the reasoning processor would translate the output into a case to be solved a current problem by CBR module. We will implement a prototype for the model as a proof of concept using java and MySQL.

II. Background and Current Situation

2.1. Case-based reasoning (CBR)

Case-based reasoning (CBR) is an intelligent-systems method that enables information managers to increase efficiency and reduce cost by substantially automating processes such as diagnosis, scheduling and design. A case-based reasoner works by matching new problems to "cases" from a historical database and then adapting successful solutions from the past to current situations [3] [4].

CBR is not only a powerful method for computer reasoning, but also a pervasive behavior in everyday human

problem solving; or, more radically, that all reasoning is based on past cases personally experienced. This view is related to prototype theory, which is most explored in cognitive science.

2.1.1. The CBR cycle

At the highest level of generality, a general CBR cycle may be described by the following four processes:

1. RETRIEVE the most similar case or cases
2. REUSE the information and knowledge in that case to solve the problem
3. REVISE the proposed solution
4. RETAIN the parts of this experience likely to be useful for future problem solving

A new problem is solved by retrieving one or more previously experienced cases, reusing the case in one way or another, revising the solution based on reusing a previous case, and retaining the new experience by incorporating it into the existing knowledge-base (case-base). The four processes each involve a number of more specific steps, which will be described in the task model. In figure 1, this cycle is illustrated.

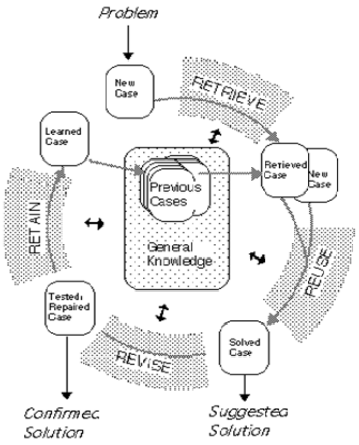

Fig. 1 The Case Based Reasoning Cycle

In case-based reasoning (CBR), system expertise is embodied in a library of past cases, rather than being encoded in classical rules. Each case typically contains a description of the problem, plus a solution and/or the outcome. The knowledge and reasoning process used by an expert to solve unrecorded problem, but it is implicit in the solution. To solve a current problem: the problem is matched against the cases in the case base, and similar cases are retrieved. The retrieved cases are used to suggest a solution which is reused and tested for successful case. If necessary, the solution is then revised. Finally the current problem and the final solution are retained as part of a new case.

2.2. Cognitive mappings

Cognitive mapping is the means through which individuals process their environment, solve problems and use memory. Cognitive mapping may be defined as a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls, and decodes information about the relative locations and attributes of phenomena in their everyday spatial environment. The popular cognitive mapping technique is called concept mapping [5] which is graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line linking two concepts. Words on the line referred to as linking words or linking phrases, specify the relationship between the two concepts. The links between the concepts can be one-way, two-way, or non-directional. The concepts and the links may be categorized, and the concept map may show temporal or causal relationships between concepts [2].

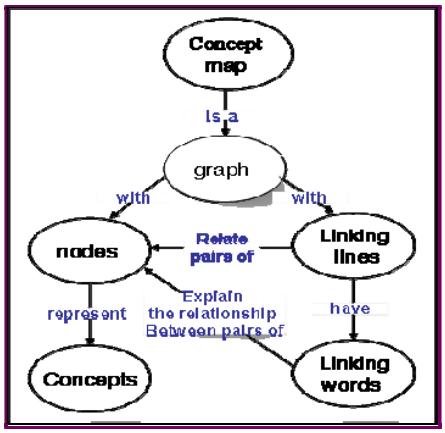

Fig. 2 The concept map of concept mapping

So we will build concept map for Autism Rating Scale takes into accounts the experts' directives to solve our problem using Graph Theory [6] which is mathematical structures used to model pair wise relations between objects from a certain collection.

III. Literature Review

The subject that concerns us here: The use of the ideas of computer science and AI techniques that were implemented and approved their success with the mentally handicapped and particularly those suffering from autism ought to discover them.

3.1. Human computer interface (HCI)

Intelligent user interfaces are designed to facilitate problem-solving activities where reasoning is shared between users and the machine, they are currently transitioning from the laboratory to applications in the workplace, home, and

classroom.

The AutiSTIC project [7], in the service of psychiatric of La Rochelle hospital, had aimed at improving computer games by addressed attention analysis issues, for diagnosis and training of the children with autism and accompanying mental disorders. They tackle this problem by defining a robust measure of attention. This measure is defined by analyzing the gaze direction and the face orientation, and incorporating the child's specific profile.

During a session, the system collects by various devices (camera, touch screen, mouse, keyboard...) the child's reactions, in order to understand his behavior but now, scientists turned to study brain computer interface (BCI) by the electroencephalograph (EEG) to measure the degree of attention that is more accurate than other devices [8].

Anyway, the modeling of that approach uses model of the knowledge of experts, the user profile and the dynamic of their interactions. If we use this adaptive approach, we can help teachers to treat these children in our study.

An Expert System for Special Education (ESSE) [9] was developed through the process of knowledge-gaining which is gathered from various expertise in chosen domain. ESSE knowledge-based resulted from the knowledge engineering called Qualifiers and Choice. Both are gathered from the analysis of symptoms that are experienced by Autism and Dyslexia patients. Every type of disability is divided to several categories and subcategory to facilitate question's arrangement. The strength of this model is that users are allowed to recognize changes that are needed in future enhancement based on information and knowledge add by expertise.

The using of Cognitive Map in ESSE system supports the clinical diagnostic features in learning disabilities to identify children of Autism or Dyslexia. We will use Concept Maps to Graphically Build Knowledge Bases. However, Cognitive mapping process individuals environment, solve problems and use memory.

3.2. Integrations with case-based reasoning

The new hybrid approaches will achieve new synergies and improve problem solving capabilities in AI [3]. In this section, we summarize work in integrating case-based reasoning (CBR) with other reasoning techniques depending on the application. Numerous examples of hybrid systems [10], with pointers to acronym of systems, are provided:

1) Integration with rule-based reasoning ex. SaxEx
2) Integration with model-based reasoning ex. CREEK
3) Integration with constraint satisfaction problem solving ex. IDIOM
4) Integration with information retrieval ex CARE-PARTNER integrates CBRRBR and IR
5) Integration with planning ex HICAP

It also integrated with other software system components such as Multi-Agent Systems (MAS) which represents an appropriate approach for solving inherently distributed problems. The system [11] was combined them in order to observe and analyze user's behaviors in the scope of educative games. They had used CBR for the decision-making. CBR provides a framework relevant to create Protocol adapted to the each child profile. Thus they can extract conclusions relating to her/his behavior and provide in a real time personal way adequate activities, keeping in mind the expert's advice. They had developed an agent with DIMA that observes the child's actions .during the session and reacts in each exception by modifying the Protocol. These information as well as the profiles of children are stored in a data server.

The important point in this research is the idea of using the Case Based Reasoning technique with other software system components which has been developed to support in decision making to find relevant similar problems. CBR is also particularly good at diagnosis systems that try to retrieve past cases whose symptom lists are similar in nature to that of the new case and suggest diagnoses based on the best matching retrieved cases.

We try to use it for solving our problem. But Knowledge acquisition is a hard, time consuming task in general. Therefore we will apply both cognitive map (CM) and case-based reasoning (CBR) techniques to formalizing, storing, and reusing knowledge more effectively. However the combination of (two or more) different problem solving and knowledge representation methods is a very active research area in AI..

IV. Methodology

The subject which concerns us here: the use of computer techniques to provide diagnostics Assistant for discovering autistic people. Thus the goal of this research is:

"To produce a prototype of Expert System that combine Cognitive Maps with Case Based reasoning method in order to reduce time and costs of traditional diagnosis process for the early detection to discover autistic children in Elementary school"

Accordingly, to achieve our goal, we plan to follow the following methodology:

- Building background on the following subjects:
  1) Review of the concept of Autism and diagnostic criteria for diagnosing autism which are entirely behavioral such as Autism Rating Scale takes into account the expert's directives.
  2) Review Graph Theory algorithms.
  3) Cognitive mapping techniques
  4) Case representations and Case-Based Diagnosis.
  5) Case-based reasoning (CBR) and its four processes

- Analysis:

1) Comparing Graph Theory algorithms for building concept map where the output of a CM used in decision-making.
2) Analyzing and comparing case retrieval methods. In many cases, must "compete" against each other in order for only one of them to dominate and be considered the correct decision.
3) Analyzing and comparing Case storage models.
4) Analyzing the effect of using CBR with CM
5) Analyzing the effect of using student data on designing Cases and hence utilizing it for CBR.

- Work towards the goal:

1) Building and designing a CM module that appropriates with the chosen Autism Rating Scale where the concepts can be considered as symptoms and cause factors. The links between these factors may be categorized.
2) Specify a case retrieval method and Case storage model that retrieve the most similar cases to the current case problem.
3) Design the structure of CBR system formalism, which is dependent on student data and the expert's objectives.
4) Designing architecture of our Expert System that combine CBR with CM module.
5) Building a prototype of our system through flowchart then designing interactive screens by java Creator and dealing with Student data which is stored in a database. These screens will be as java classes that will have a user (teacher) interface. By using this interface , the expert system can do the following steps:

1) The teachers enter student's information for analyzing by CM module which will include the basic stages for building CM see figure 3. Each node may represent one or more points from criteria of diagnosing autism .

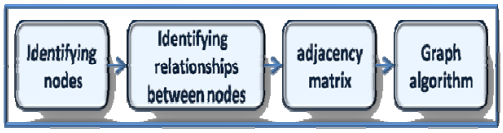

Fig. 3 The basic stages for building CM

2) Then, the reasoning processor module will take the output from CM module and convert it into a case for solving a current problem by CBR cycle that we have described in section II.
3) The repaired case will store in DB and produce diagnosis screen in user interface.
4) Figure 4 depicts our current elementary thoughts about the proposed expert system. Of course, this is a very sample idea, which is surely expected to evolve as the research becomes more mature.

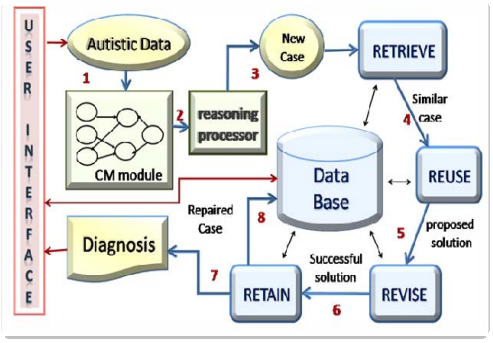

Fig. 4 The illustration of the proposed expert system

6) Implement a prototype for the model as a proof of concept using java and MySQL.
7) Analyzing the results and providing recommendations.

Our expert system will provide a new hybrid approach that will achieve new synergies and improve problem solving capabilities in AI. And we will predict that this hybrid approach will accomplish the following:

- Reduce time and costs of traditional diagnosis process where the speed of reaching a solution is very important. Even the most accurate decision or diagnosis may not be useful if it is too late to apply.
- Reduce the number of human errors
- Make knowledge and expertise available to more people

On the other hand, It will help the teachers to connect with Autistic children in order to overcome the barriers they face in their classes and increased a parent‘s participation in planning therapies and the awareness about this disorder.

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