Learning Disorder Analysis using Logic Programming Approach

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Abstract

This paper reviews dyslexia and the effect it has on the lives of children and adults. In the paper I present a diagnosis system for dyslexia using prolog approach which called PSDD : prolog based system for dyslexia diagnosis. I explain the motivation, general idea and initial results in the term of user requirements and system architecture. Besides, teachers maintain significant level of information pertaining learning disabilities, thus reduce amount of human errors.

Keywords : *Dyslexia; logic programming; diagnosis; user requirements*.

1. Introduction

Dyslexia is a disorder affecting up to 17% of the population.[1],[2],[3],[4],[7] People with dyslexia often think in different ways. Dyslexia particularly affects the handling of symbolic information especially written language.

The British Psychological Society's Division of Education and Child Psychology drew together widespread research showing that dyslexia has multiple causes and the appropriate intervention consists of frequently delivered and highly structured phonic learning, word reading and spelling skills programs.

Their definition of dyslexia is as follows:

"Dyslexia is evident when accurate and fluent word reading and/or spelling develops very incompletely or with great difficulty. This focuses on literacy learning at 'word level' and implies the problem is severe and persistent, despite appropriate learning opportunities."[1]

An independent report, dated June, 2009, from Sir Jim Rose to the Secretary of State for Children, Schools and Families refers to dyslexia as….

'Dyslexia is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling.'[2].

Children have this problem when they struggle to acquire word reading and/or spelling skills and knowledge despite appropriate intervention.

Dyslexia can cause frustration and negative feelings about competencies for some children and in turn this might cause behavior problems. History is full of examples of great people who have overcome dyslexia to achieve enormous success – Albert Einstein being probably the most famous. However, Dyslexia is worrying for both parents and educators.[1], [6], [8], [9].

The main objective of this paper is to present PSDD system which can :

- Helps new teachers to know what type and degree of disability that each of their students may have.
- Helps educators to categorize the students into a suitable curriculum activity based on students disability.
- Helps parents and educators to monitor the performance and progress of a dyslexic user and his current emotional / physical states. In addition PSDD supports them with recommendations to enhance dyslexics, raise their level and awareness in treating with this disorder.

The rest of the paper is organized as follows. The next section provides overview on dyslexia causes and treatment. Section three describes the main architecture of the proposed system (PSDD). In section four I highlight the usage of prolog as an approach for the diagnosis module, some examples of rules and facts are provided, while section five concludes the paper.

2. Overview on Dyslexia

Dyslexia is identified through good record keeping of children's spelling and word reading progress over time which includes monitoring the child's responses to the application of well-founded intervention.

Individual focused intervention can dramatically improve many children's reading and spelling performance. Research shows that on average, good intervention makes a positive difference of two months per month to reading and spelling age.

2.1. What causes dyslexia?

The causes of dyslexia fall into two broad categories:- [1], [6].

neurological e.g. genetic inheritance, forms of damage to the brain during or post birth;

environmental e.g. lack of exposure to reading, reduced motivation and self-esteem in relation to reading and spelling, unvaried methods of teaching word reading and spelling, for example total use of synthetic phonics approaches will disadvantage children who are more successful at being able to recognize whole words but struggle to split words into sound patterns or build sounds into words.

The problem for the investigator trying to pinpoint a cause is that factors within these two broad categories interrelate and neurological problems can cause environmental ones and vice versa.

Measuring and observing a child's reading and spelling abilities and their progress in relation to well-founded support programs, is the most robust way of telling whether a child has dyslexia.

Parents and educators involved in teaching a child to read and spell are well placed to identify struggling readers and spellers. Teachers can then provide effective interventions to meet the child's individual needs that accelerates the learning process.

3. The Main Architecture of the Proposed System

The architecture of the proposed system consists of four main components. Figure 1 shows the main architecture of the proposed system and the data flow.

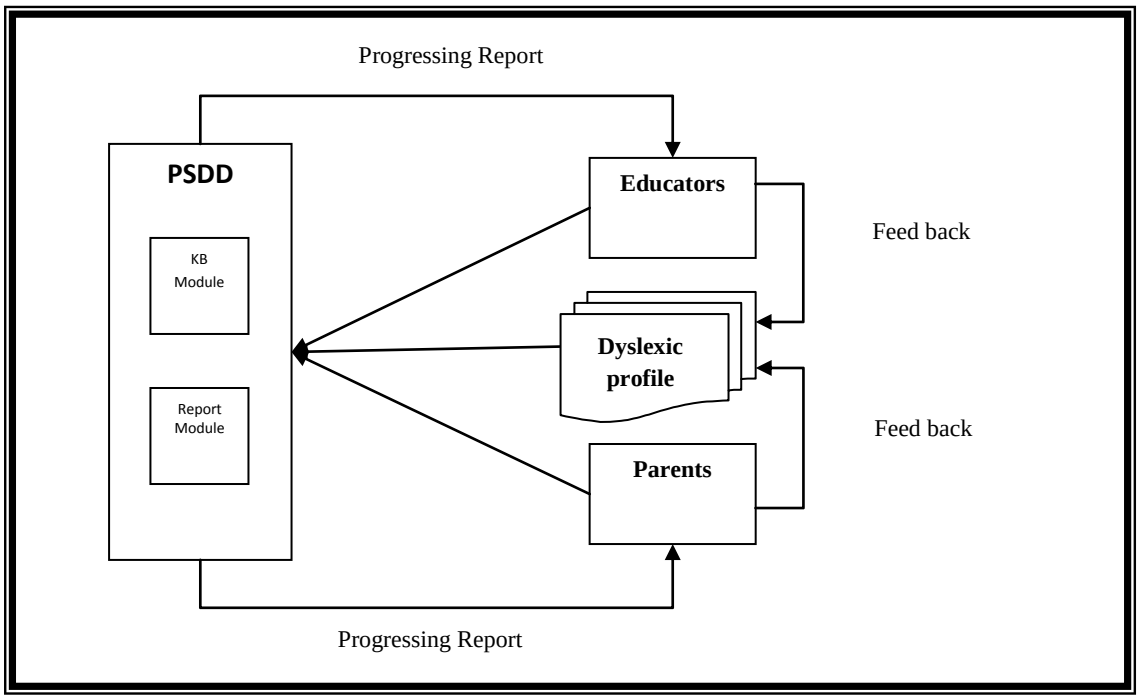

Figure 1. The main architecture of the proposed system

3.1. The Components of the System

3.1.1 PSDD component

Which includes mainly two modules, knowledge base module and report generator module. Next section will cover this component in detail, also some examples for prolog facts and rules will be highlighted.

3.1.2 Dyslexic's profile component

3.1.3 Educator component

Which includes teachers and educators experts of dyslexia.

3.1.4 Parent component

Which includes parents of the dyslexic

3.2 Data flow

3.2.1 System inputs

a - Test and state of the dyslexic through PSDD to define the initial diagnosis
b- Report of the case by the educators through PSDD.
c- Report of the case by the parents through PSDD.

3.2.2 System output

a- Progressing report provided by the PSDD each period of time, this period will be defined by the educators due to the progressing rate, normally this period around two to three months.

b- The progressing report will include some recommendations to the educators and the parents to guide them through the treatment of the case.

4. Usage of PSDD

Prolog as a logic programming language provides many possibilities to realize a task. [11], [12]. It is considered to be difficult to be implemented because of the simple syntax and the concept of recursive programming. In addition, the domain of logic programming is infinite. For a given programming task, there is no single solution, but many strategies to design a solution.

In PSDD system we are interested in diagnosis domain using simple syntax through Arabic questions to get simply clear answers from the dyslexics, recursive concept to generate periodic reports for the evaluations considerations and using the constraint-based modeling (CBM) concept to define the level of the dyslexics in percentage in order to monitor the progressing rate.[10], [12].

4.1 Aspects of questions through PSDD. Figure 2. Arabic questions examples

Questions about vision, reading and spelling.
Questions about behavior, health, development and personality spelling.
Questions about disorientation.
Questions about writing and motor skills.
Questions about math and time management.
Questions about memory and cognition.

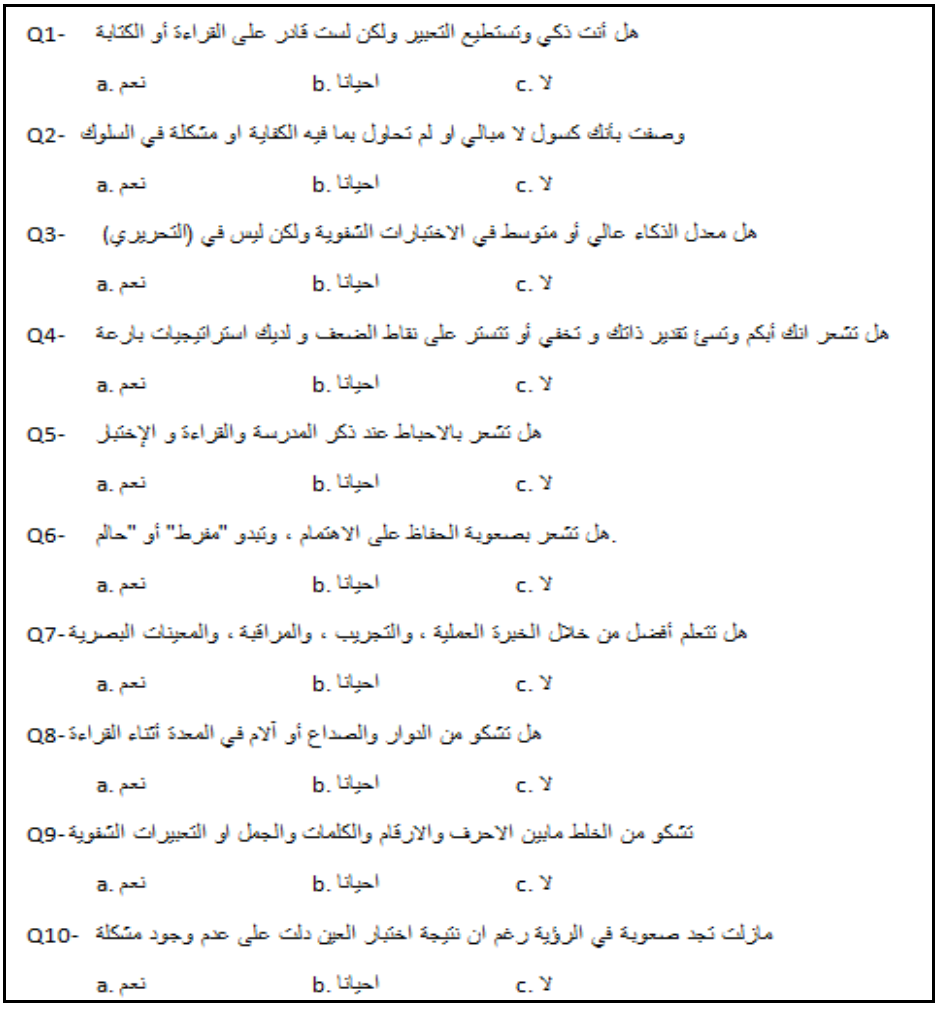

Figure 2 shows example of Arabic questions.

4.2. Example of Facts in PSDD

- Fact1: “Complains of dizziness, headaches or stomach ache while reading”.
- Fact2: “Confused by letters, numbers, words, sequences, or verbal explanations”.

4.3. Example of rules in PSDD

The main rule in PSDD is to calculate the result of each aspect as an individual by itself and evaluate its percentage , every aspects has two counters so if the answer is yes it adds 1 to the x counter and if maybe then it will add 1 to the s counter. Figure 3

```
print:-nl,write('a. yes'),nl,write('b. somewhat'),nl,
write('c. no'),nl,write('d. exit from test'),nl.
print1:- write('Next Question is:').
choice(a,L,N,S):- print1,nl,count(N,Z),M is L+1,menu(M,Z,S).
choice(b,L,N,S):- print1,nl,count1(S,Z),M is L+1,menu(M,N,Z).
choice(c,L,N,S):- M is L+1,menu(M,N,S).
choice(d,L,N,S):- end(S).
choice(_,L,N,S):- write('False. Please enter a. , b. , c.
!'),nl,menu(L,N,S) .
count(X,Y):- Y is X+1.  /*counter for count all answer yes/*
Sum is ((X*12.5)+(S*6.25)),write(Sum)
men7(Sum,Sum1,Sum2,Sum3,Sum4,Sum5):- Q is
Sum+Sum1+Sum2+Sum3+Sum4+Sum5, Q>49 -> write('you have probably have
dyslexia approximately :'),G is Q/6,write(G),write('%'),nl,
```

Figure 3. Shows some calculations of the results using CBM in prolog

After calculating each aspect alone, the average of all aspects will be given in percentage as shown in figure 3.

PSDD gives some explanations and definitions for the aforementioned aspects to facilitate and explain the meaning for the nonprofessional persons. For example figure 4. Explain what does it mean by disorientation and what is the symptom for this disorder.

```
in(D):- write('Disorientation :'),nl, write('means a shift of
perception triggered by confusion or stress. the person  gets an
inaccurate picture of'),nl, write('the environment, or is looking
at mental images instead'),in1(X).
```

Figure 4. Explains what does it mean by disorientation

Recommendations to the educators and parents are provided to facilitate the treatment of the dyslexics. Figure 5.

These recommendations are changed due to the current evaluation of the case and the progressing rate.

Normally PSDD will modify the recommendations each report to go along with the progressing rate of the case. PSDD has the ability to add new recommendations or modify the old one if necessary.

```
m(X):- nl,nl,write('1-get help from the nearest
center'),nl,write('2-try reading on colored surface '),nl,
write('3- dyslexic needs an additional balanced literacy learning
program. This should contain a combination of word level work -
learning about phonics'), nl,write('4- dyslexic shares text reading
with a more experienced reader and is read to. '), nl,write('5-
dyslexic needs to learn vocabulary and richer language structures
and genre.'), nl,write('6- break words into letter-sound patterns
and learning these to decode other words
'),.........etc
```

Figure 5. Some examples of recommendations to the educators and parents

5. Conclusions and future work

This paper discusses PSDD which diagnoses dyslexia cases in Arabic and simple way. PSDD generates periodic reports which reflect the change and enhancement of the case according to the recommendations provided to the educators and the parents. These recommendations will help them to support the dyslexics to overcome this disorder.

As for future work we would like to include a sound recorder to read test questions, and to modify the fonts so it can be readable by dyslexic people, and try to include oral tests in it, such as written text and the person enters the answers as the meaning of the text...etc.

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