International Journal of Informatics, Economics, Management and Science (IJIEMS)
http://journal.stmikjayakarta.ac.id/index.php/ijiems
E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i1.1227
Volume 3, Issue 1 , January 2024, pp. 69-83

Determination of the Type of Child Development Disorders with the Dempster Shafer Method

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Received: July 28, 2023; **Accepted**: December 18,2023 ; **Published**: January 23, 2024

Abstract: Children are the most beautiful gift for parents. These awards sometimes have deficiencies or many of them experience disturbances during their development. There are various kinds of developmental disorders that children suffer from, including: autism, ADHD, ADD, speech delay, Asperger's syndrome, and Taurette's syndrome. In Indonesia, 5% of the school-age population to some degree suffers from developmental disorders, one of which is Hyperactivity Disorder. Hyperactivity Disorder is experienced more by boys than girls, with an estimate of 2-4% for girls, and 6-9% for boys aged 6-12 years. One of the real challenges nowadays is the high cost to do a health check. So that many children are not brought by their parents to undergo examinations because of limited funds. In addition to funding, the lack of experts or specialists in the field of child health is also a factor for parents' reluctance to have their children examined. Situations that often occur in areas, especially those far from the city center. In this study, the Dempster Shafer method will provide an initial diagnosis and classification of the types of child development disorders into several classifications such as in the case of Hyperactivity Disorder, with the categories of Hyperactivity, Impulsivity and Inattention. Based on the results of manual calculations using the Dempster Shafer, a presentation value of 0.6 is obtained leading to inclusive disease. It is also a factor that parents are reluctant to have their children examined. Situations that often occur in areas, especially those far from the city center. In this study, the Dempster Shafer method will provide an initial diagnosis and classification of the types of child development disorders into several classifications such as in the case of Hyperactivity Disorder, with the categories of Hyperactivity, Impulsivity and Inattention. Based on the results of manual calculations using the Dempster Shafer, a presentation value of 0.6 is obtained leading to inclusive disease. It is also a

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factor that parents are reluctant to have their children examined. Situations that often occur in areas, especially those far from the city center. In this study, the Dempster Shafer method will provide an initial diagnosis and classification of the types of child development disorders into several classifications such as in the case of Hyperactivity Disorder, with the categories of Hyperactivity, Impulsivity and Inattention. Based on the results of manual calculations using the Dempster Shafer, a presentation value of 0.6 is obtained leading to inclusive disease. and Intention. Based on the results of manual calculations using the Dempster Shafer, a presentation value of 0.6 is obtained leading to inclusive disease. and Intention. Based on the results of manual calculations using the Dempster Shafer, a presentation value of 0.6 is obtained leading to inclusive disease.

Keyword : Dempster Shafer, Expert System, Hyperactivity Disorder

1. Introduction

Children are the most beautiful gift for parents. These awards sometimes have deficiencies or many of them experience disturbances during their development. There are various kinds of developmental disorders that children suffer from, including: autism, ADHD, ADD, speech delay, Asperger's syndrome, and Taurette's syndrome.

According to (Sugiarmin et al. 2018), in Indonesia, 5% of the school-age population to a certain degree experience developmental disorders, one of which is Hyperactivity Disorder. According to Barkley in (Baihaqi et al. 2018) Hyperactivity Disorder has been studied in several countries, revealing a comparative estimation system for countries where their children suffer from Hyperactivity Disorder. Japan 2%, China 2%, United Arab Emirates 15%, Italy, Ukraine 20% and India 29%. Various types of Hyperactivity Disorder are defined in many countries.

One of the real challenges nowadays is the high cost of conducting health checks. So that many children are not brought by their parents to undergo examinations because of limited funds. In addition to funding, the lack of experts or specialists in the field of child health is also a factor for parents' reluctance to have their children examined. Situations that often occur in areas, especially those far from the city center. So that when children experience disorders, they are only taken to health services in the area.

In this study, the Dempster Shafer method will provide an initial diagnosis and classification of the types of child development disorders into several classifications such as in the case of Hyperactivity Disorder, with the categories of Hyperactivity, Impulsivity and Inattention. By using the website, users can easily find out what types of disorders are detected in their children. Disorders of child development are interesting to study. Hyperactivity Disorder needs to be watched out for. If not watched out for it can have an impact on the development of children in the future

2. Literature

This previous research is one of the references in conducting research so that it can enrich

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the theory used in reviewing the research conducted. In this study the authors take references from several writings.

According to (Doddy Teguh Yuwono 2019) the expert system is able to detect personality disorders based on the symptoms felt, without having to ask experts directly. The accuracy value of the diagnostic system is 85%.

According to (Dina Hastar 2018) research results, expert systems are able to diagnose children's mental disorders. The tests used are black boxes, theoretical calculations, accuracy, laboratories and questionnaires.

According to (Muh Tariq Hasan 2018) the damster shafer method can calculate the symptoms that have been
selected by the user. Damster shafer method is able to issue a proper diagnosis.

2.1 Expert system.

An expert system (Hayadi, B. Herawan.2018) is a computer software that has a knowledge base for a particular domain and uses inference reasoning like an expert in solving problems.

2.1.1 Expert System characteristics.

According to Nurajizah (2018) in making an expert system, it is necessary to know the characteristics and categories of expert system problems, in general expert systems are:

a. Have reliable information, both in showing intermediate steps and in answering questions about the completion process.
b. Easy to modify, namely by adding or removing a capability from the knowledge base.
c. Can be used in various types of computers.
d. Have the ability to adapt.

2.1.2 Expert System Advantages.

There are several advantages that can be obtained from making an expert system according to Arhami (in Rizka.2019), namely:

a. Makes knowledge and advice more accessible.
b. Increase output and productivity.
c. Storing expert skills and expertise.
d. Improve reliability.
e. Give a quick response (answer).
f. Is a smart guide.
g. Can work with incomplete information and contains uncertainty.
h. Smart database, that expert system can be used to access the database in a smart way.

2.1.3 Weaknesses of Expert Systems.

In addition to the expert system having advantages, according to Nurajizah (2018) the expert system also has weaknesses, namely:

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a. Problems in obtaining knowledge where knowledge is not always obtained easily, because sometimes the expert on the problem we create doesn't exist, and even if there is sometimes the approach that the expert has is different.
b. To create a really high-quality expert system is very difficult and requires a very large cost to develop and maintain.
c. It may be that the expert system cannot make a decision.
d. Expert systems are not 100% profitable, because someone who is involved in an expert system is not always right. Therefore it needs to be re-tested carefully before use.

2.1.4 Reasons for Developing Expert Systems

According to Nurajizah (2018) the development of the expert system itself will be further developed for the following reasons:

a. The knowledge of an expert is expensive.
b. An expert will one day retire from his job and may even die so that the knowledge of the expert will be lost and cannot be passed on to more junior experts.
c. It can automatically perform routine tasks that require an expert.
d. Expertise is also needed at any time and in various locations, even in locations that lack or do not support it.

2.1.5 Expert System Components

According to Anita R (2020), the main components of an expert system include:

1. Knowledge Base

   The knowledge base is the core of an expert system, which is in the form of a knowledge representation of the expert. The knowledge base is composed of facts and rules. Fact is information about object, event and situation. The rule is a way to generate a new fact from the facts that are already known.

2. Inference Engine (Inference Engine)

   The inference engine acts as the brain of the expert system. The inference engine functions to guide the process of reasoning about a condition, based on the available knowledge base, in the inference engine a process occurs to manipulate and direct rules, models, and facts stored in the knowledge base in order to reach a solution or conclusion, in the process the inference engine using reasoning strategies and control strategies.

3. Database (Data Base)

   The database consists of all the necessary facts, where these facts are used to fulfill the conditions of the rules in the system. The database stores all the facts, both the initial facts when the system started operating, and the facts obtained when the conclusion drawing process was being carried out. The database is used to store observed data and other data needed during processing.

4. User Interface (User Interface)

   This facility is used as an intermediary for communication between the user and the computer.

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2.2 The Dempster Shafer Method

There are various kinds of reasoning with complete and very consistent models, but in reality there are many problems that cannot be completely and consistently resolved (Anita Rosana, 2020). This inconsistency is due to the addition of new facts. Such reasoning is called non-monotonic reasoning. To overcome this inconsistency, reasoning with Dempster Shafer's theory can be used. In general, Dempster Shafer's theory is written in an interval (Wijaya, IGPS2020): [Belief, Plausibility]

Belief(Bel) is a measure of the strength of evidence in supporting a set of propositions. If it has a value of 0 then it indicates that there is no evidence, and if it has a value of 1 it indicates certainty. Plausability (Pl) is denoted as: Pl(s) = 1-Bel(s)

*Playability*is also worth 0 to 1. If you are sure of s, then it can be said that Bel(s)=1, and Pl(s)=0. In Dempster Shafer's theory, there is a known frame of discernment denoted by θ. This frame is the universe of discussion from a set of hypotheses. The goal is to relate the confidence measure of the elements θ. Not all evidence directly supports each element. For this reason, it is necessary to have a probability density function (m). The value of m defines not only the elements of θ, but also all of its subsets. So if θ contains n elements, then the subsets of θ all add up to 2n, we must show that the sum of all m in the subset θ is equal to 1. Calculations using the Dempster Shafer method are performed by calculating the values for the belief and plausability functions, as well as the combination of the evidence mass function (symptoms) present.

$$\text{Bel}(X) = \sum_{Y \subseteq X} m(Y) \quad \ldots\ldots(1)$$

and Plausibility is denoted in equation (2):

$$\text{Pls}(X) = 1 - \text{Bel}(X) = 1 - \sum_{Y \subseteq X} m(Y) \quad \ldots\ldots(2)$$

Where :
Bell (X) = Beliefs (X)
Pls (X) = Plausibility (X)
m(X) = mass function of (X)
m(Y) = mass function of (Y)

Dempster Shafer's theory states that there is a frame of discrimination denoted by the symbol (Θ). The frame of discretion is the universe of discussion from a set of hypotheses so that it is often called the environment as shown in equation (3):

$$\Theta = \{ \theta 1, \theta 2, \ldots \theta N \} \quad \ldots\ldots(3)$$

Where :
Θ = frame of discretion or environment
θ1,…,θN = element / element in the environment

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The environment contains elements that describe possible answers, and only one will match the required answer. This possibility in Dempster Shafer's theory is called a power set and is denoted by P (Θ), each element in this power set has an interval value between 0 to 1.

m : P (Θ) →[0,1]

So that it can be formulated in equation (4):

$$\sum_{X \leq P(\Theta)} m\ (X)=1 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

With :
P(Θ) = power sets
m (X) = mass function (X)

The mass function (m) in Dempster Shafer's theory is the confidence level of an evidence (symptom), often referred to as an evidence measure so it is denoted by (m). The goal is to relate the confidence measure of the elements θ. Not all evidence directly supports each element. For this reason, it is necessary to have a probability density function (m). The value of m defines not only the elements of θ, but also all of its subsets. So if θ contains n elements, then the subset of θ is 2n. The sum of all m in the subset θ is equal to 1. If there is no information whatsoever to choose a hypothesis, then the value:

m{θ} = 1.0

If it is known that X is a subset of θ, with m1 as its density function, and Y is also a subset of θ with m2 as its density function, then the combined function of m1 and m2 as m3 can be formed, which is shown in equation (5):

$$m3(Z) = \frac{\sum X \cap Y{=}Z\ m_1\ (X).\ m_2\ (Y)}{1\text{-}\ \sum X \cap Y{=}\emptyset\ m_1\ (X).\ m_2\ (Y)} \ldots\ldots\ldots\ldots\ldots (5)$$

Where :
m3(Z) = mass function of evidence (Z)
m1s(X) = mass function of evidence (X), which is obtained from the value of confidence an evidence multiplied by the disbelief value of the evidence.
m2(Y) = mass function of evidence (Y), which is obtained from the value of confidence an evidence multiplied by the disbelief value of the evidence.

3. Methods

3.1 Supporting data

Data processing by carrying out the process of converting raw data into useful and easily accepted information. In this case data processing is carried out related to diseases and symptoms of the developmental disease of Hyperactive Disorder. This symptom is a knowledge base for making a conclusion which is the goal of this expert system. The following symptoms are common symptoms experienced by patients with Developmental Hyperactive Disorder. The

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following is table III.1, namely a table of symptoms and types of disease Developmental Hyperactive Disorder.

Table 1 Diseases and Developmental Symptoms of Hyperactive Disorder

Code	P-1	P-2	P-3
G-01	x	x	x
G-02		x	x
G-03	x		x
G-04	x	x	x
G-05		x	
G-06	x	x	
G-07	x	x	
G-08	x	x	x
G-09	x		x
G-10		x	
G-11			
G-12	x		
G-13			x
G-14			
G-15		x	
G-16	x		
G-17			
G-18			x
G-19	x		
G-20		x	
G-21		x	

Table 2 Categories of Hyperactive Disorder

Code	Category Name
P-1	Hyperactive
P-2	impulsive
P-3	Intention

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Table 3 Symptoms of Developmental Hyperactive Disorder

Code	Symptom
G-1	Often leaves seat in classroom or in other situations where remaining seated is expected
G-2	Often fidgets with hands or feet or squirms in seat
G-3	Often forgets about daily activities
G-4	Often easily distracted by external stimuli
G-5	Often loses things needed for tasks or activities (e.g. toys, schoolwork, pencils, books or tools)
G-6	Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
G-7	Often has difficulty organizing tasks and activities
G-8	Often does not follow instructions and fails to complete schoolwork, assignments or work obligations (not due to opposing behavior or failure to understand instructions)
G-9	Often seems not to listen when spoken to directly
G-10	Often has difficulty sustaining attention in task activities or play
G-11	Often fails to pay attention to detail or makes careless oversights in schoolwork, work or other activities

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Table 3 Continued Symptoms of the disease Development of Hyperactive Disorder

Code	Symptom
G-12	Often runs about or climbs excessively in inappropriate situations (in adolescents or adults, may be limited to subjective feelings of restlessness)
G-13	Often has trouble playing or enjoying leisure activities quietly
G-14	Often "busy" or often acts as if "controlled by a machine"
G-15	Often talk excessively
G-16	Often answers without thinking before the question is over
G-17	Often has trouble waiting their turn
G-18	Often interrupts or interrupts others (for example, interrupting conversations or games
G-19	Often easily frustrated and hopeless
G-20	Often his request must be fulfilled immediately
G-21	Often impatient

3.2 Case study

The process of testing the system is in the form of entering data on the symptoms experienced by the patient. In the first test, some of the symptoms experienced by the patient include:

G-1 (Often leaves seat in classroom or in other situations where remaining seated is expected)

G-2 (Often fidgets with hands or feet or squirms in seat)

From the results of the consultation, a total of two symptoms were selected, so to obtain a possible value using the Dempster's Rule of Combination table, the selected symptoms could be calculated:

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m1(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)=0.77
m1(θ)=1- 0.77= 0.23
m2(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12)= 0.63
m2(θ) =1- 0.63= 0.37

Based on the existing data, it is then combined with a formula in accordance with Dempster's Rule of Combination as shown in table III.4 below:

Table 4 Table Dempster Rule of Combination 1

	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.63	m2(θ) = 0.37
(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.77	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.49	(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.28
m1(θ) = 0.23	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.14	m3(θ) = 0.09

m3(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.49 = 0.49
1-0

m3(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.14 = 0.14
1-0

m3(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.28 = 0.28
1-0
m3(0) = 0.06 = 0.09
1-0

Then the child has "Often has difficulty managing tasks and activities" (G-07) as the 3rd symptom, then:

m4(P-1, P-2, P-6, P-7, P-10) = 0.83
m4(θ) = 1-0.83 = 0.17

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Table 5 Dempster Rule of Combination 2

	m4((P-1, P-2, P-6, P-7, P-10) = 0.83	m4(θ) = 0.17
(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)= 0.49	(P-2, P-6, P-7)= 0.4067	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)= 0.0833
(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12)= 0.14	(P-2, P-6, P-7,P-10) = 0.1162	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.0238
(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)= 0.28	(P-1,P-2, P-6, P-7)= 0.2324	(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.0476
m3(θ) = 0.09	(P-1, P-2, P-6, P-7, P-10)= 0.0747	m5(θ) = 0.0153

m5(P-2, P-6, P-7) = 0.4067 = 0.4067
1-0
m5(P-2, P-6, P-7, P-10) = 0.1162 = 0.1162
1-0

m5(P-1, P-2, P-6, P-7) = 0.2324 = 0.2324
1-0

m5(P-1, P-2, P-6, P-7, P-10) = 0.0747 = 0.0747
1-0

m5(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.0833 = 0.0833
1-0

m5(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.0238 = 0.0238
1-0
m5(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.0476 = 0.0476
1-0

m5(0) = 0.0153 = 0.0153
1-0

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Then the child has "Often has difficulty sustaining attention in task activities or games" (G-10) as the 4th symptom, then:

m6(P-7,P-8,P-11,P-12) = 0.725

m6(θ) = 1-0.725 = 0.275

Table 6 Dempster Rule of Combination 3

	m6(P-7,P-8,P-11,P-12) = 0.725	m6(θ) = 1-0.8 = 0.275
m5 (P-2,P-6,P-7)=0.4067	P-7)= 0.2948575	(P-2,P-6,P-7)= 0.1118425
m5 (P-2,P-6,P-7,P-10)= 0.1162	(P-7) = 0.084245	(P-2,P-6,P-7,P-10)= 0.031955
m5 (P-1,P-2,P-6,P-7) = 0.2324	(P-7)= 0.16849	(P-1,P-2,P-6,P-7) = 0.06391
m5 (P-1,P-2,P-6,P-7,P-10)= 0.0747	(P-7)= 0.0541575	(P-1,P-2,P-6,P-7,P-10)= 0.0205425
m5 (P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)= 0.0833	(P-7,P-8,P-11,P-12)= 0.0603925	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)= 0.0229075
m5 (P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.0238	(P-7,P-8,P-11,P-12)= 0.017255	(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-10, P-11, P-12)= 0.006545
m5 (P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.0476	(P-7,P-8,P-11,P-12)= 0.03451	(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12)= 0.01309
m5 (θ) = 0.0153	(P-7,P-8,P-11,P-12) =0.0110925	m7(θ) = 0.0042075

m7(P-7) = 0.2948575+0.084245+0.16849+0.0541575 = 0.60175
1-0

m7(P-7, P-8, P-11, P-12) = 0.0603925+0.017255+0.03451+0.0110925 = 0.12325
1-0

m7(P-2, P-6, P-7) = 0.1118425 = 0.1118425
1-0

m7(P-2, P-6, P-7,,P-10) = 0.031955 = 0.031955
1-0

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E-ISSN: 2809-8471 (online), **P-ISSN:** 2809-9281 (Print)
DOI: 10.52362/ijiems.v3i1.1227
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$m7$(P-1, P-2, P-6, P-7) = 0.06391 = 0.06391
1-0

$m7$(P-1, P-2, P-6, P-7, P-10) = 0.0205425 = 0.0205425
1-0

$m7$(P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.0229075 = 0.0229075
1-0

$m7$(P-2, P-3, P-4,P-5,P-6, P-7, P-8, P-9, P-10, P-11, P-12) = 0.006545 = 0.006545
1-0

$m7$(P-1, P-2, P-3, P-4, P-5, P-6, P-7, P-8, P-9, P-11, P-12) = 0.01309 = 0.01309
1-0

$m7$(0) = 0.0042075 = 0.42075
1-0

Based on the sequence above, using the Dempster Rule of Combination, it is possible for children with symptoms G-1, G-2, G-7, and G-10 to be impulsive (P-2) with the largest value of 0.6.

4. Results And Discussion

One of the types of disorders in children is Hyperactivity Disorder, the purpose of research using the dempster shafer is to create a system that can identify the type of disorder in children based on symptoms. Based on the selected symptoms can make it easier to diagnose the type of disorder that exists in children. The results of manual calculations show that the highest percentage level of confidence is in inclusive disease with a value of 0.6. So that when knowing the type of disorder that occurs in children, the system will provide suggestions so that parents can find out the right treatment to give to children.

5. Conclusion

With the existence of a website-based system for diagnosing types of disorders in children, especially Hyperactivity Disorder using the Dempster Shafer method, it can be used as a reference for all parties who want to recognize the types of developmental disorders of

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Hyperactive Disorder in children, can assist parents in getting advice and recommendations in dealing with developmental disorders of Hyperactive Disorder in children, as wellprovide the right solution to overcome the developmental disease Hyperactive Disorder in their children.Method*Dempster Shafer*is a simple expert system method, but can accommodate a variety of rules. Very well used for expert systems in the health sector.

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