Expert system to diagnose child development growth disorders with forward chaining method

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Abstract. Growth and development in children determine quality throughout their lives. The lack of understanding of parents about the importance of child development makes parents often ignore a situation or disease that occurs in their children. For this reason, an expert system is needed using the forward chaining method in reasoning to the knowledge base, which can help parents to know the growth problems experienced by their children based on the symptoms found in children. In its development, the expert diagnostic system for child development disorders is implemented using PHP and MySQL programming as the database. After this expert system is implemented, the system can diagnose 5 disorders of child development (Autism, Asperger syndrome, attention deficit disorders and Hyperactivity, Down syndrome, and mental retardation) especially in children aged 6 - 12 years.

1. Introduction

Growth and development are the most important aspects of a child's life because they determine the basis for the next life. Children can experience disorders in their growth and development, ignoring a situation or a disease that they consider mediocre can affect the growth and development of children later. Disorders in child development can actually be known by parents since the child was born, but the lack of understanding of parents that child development is very important to make the disorder less attention and left alone so as to make the condition of the disorder becomes severe. In line with the development of computers, computer experts try to create a technology / artificial intelligence system that is expected to have the ability to solve a problem such as an expert or expert. The technology is an Expert System. By combining the knowledge base and the inference system, this system mimics the way of thinking of an expert in diagnosing a case of disease which then helps to find the conclusions of the disease suffered and how to deal with it accordingly.

This paper is organized as follows: Introduction and background of research of this paper in section 1, literature review of research of this paper in section 2, methodology is used to of this paper in section 3, the result of research of this paper in section 4, the discussion of research of this paper in section 5, finally the conclusions of research of this paper are given in section 6.
2. Literature Review

2.1. Expert System Definition

Expert systems are artificial intelligence programs that combine base knowledge bases with inference systems to imitate an expert. An expert system is a system that seeks to adopt human knowledge to computers so that computers can solve problems as is usually done by experts [1].

- Expert System Advantage and Disadvantage
  The advantages of Expert Systems, namely:
  1. Making knowledge easier to obtain.
  2. Increase output and productivity.
  3. Store expert skills and expertise.
  4. Improve problem-solving.
  5. Increasing reliability.
  6. Provide fast response.
  7. Is a guide to intelligence.
  8. Can work with information that is incomplete and contains uncertainty.
  9. Can be used to access the database intelligently.

- Besides having advantages, Expert Systems also have several disadvantages, namely [1]:
  1. Knowledge cannot always be obtained easily. Because the approach made by one expert with other experts is different.
  2. To create a quality system that is very difficult and requires high costs.
  3. The expert system is not 100% correct, it needs to be retested before use. In this case, the role of humans is the dominant factor.

2.2 Expert System Structure

The main components in the structure of expert systems include [2]:

1. Knowledge acquisition
   This subsystem is used to enter knowledge from an expert by way of engineering knowledge so that it can be processed by a computer and put it in a knowledge base in a certain format (in the form of knowledge representation).

2. Knowledge Base
   The knowledge base contains the knowledge needed to understand, formulate, and solve problems. The knowledge base consists of two basic elements, namely:
   - Facts, for example, the situation of existing conditions and problems
   - Rule to direct the use of knowledge in solving problems

3. Inference Machine
   The Inference engine is a program that serves to guide the process of reasoning to a condition based on the existing knowledge base, manipulating and directing rules, models and facts that are stored in the knowledge base to reach solutions and conclusions.

4. BlackBoard
   To record temporary results that will be made as a decision and to explain a problem that is occurring, the expert system requires a keyboard, that is, an area in memory as a database. Three types of decisions that can be recorded on the keyboard are:
   - Plan: how to deal with problems
   - Agenda: potential actions waiting to be executed
   - Solution: prospective actions that will be generated

5. User Interface: used as a medium of communication between users and expert systems.

6. Explanation subsystem: function gives an explanation to the user how a conclusion can be taken.

7. Knowledge improvement system: The ability to improve knowledge (knowledge refining system) from an expert is needed to analyze knowledge, learn from past mistakes, then improve knowledge so that it can be used in the future.
8. User: In general, expert system users are not experts who need solutions, suggestions, or training (training) from various problems that exist. The relationship between components in a system can be described as shown in figure 1. below:

![Diagram](Image)

**Figure 1. Component Relations in an expert system**

2.3 *Forward Chaining Method*

The forward chaining method is a method of the inference engine to start reasoning or tracking data from facts that lead to a conclusion. In this approach, tracking starts from input information and then tries to draw conclusions. This search technique with known facts then matches these facts with the IF part of the IF-Then rule. If there are facts that match the IF section, then the rule is executed. If a rule is executed, a new fact (part THEN) is added to the database. Every time matching starts from the top rule. Every rule is only bole executed once. The matching process stops when there are no more rules that can be executed [1].

3 *Methodology*

3.2 *Rule Process Analysis Interference*

| Number | Description of Rule |
|--------|---------------------|
| Rule 1 | IF Children’s emotional state is unstable (G001)  
AND Poor children socialization ability (G002)  
AND Children cry or laugh without cause (G003)  
AND Children’s eye contact is less when spoken to (G007)  
AND Children speaking ability is lacking (G008)  
AND Children are not interested in watching or playing with other children (G009)  
AND How to play children is less varied and imaginative (G010)  
AND Children make strange movements that are repeated (G011)  
AND Children are fixated on useless activities (G012)  
THEN Autism (P001) |
| Rule 2 | IF Poor children socialization ability (G002)  
AND Children experience motor development that is slow, like being able to use an object (G004)  
AND Children's eye contact is less when spoken to (G007)  
AND Children have a monotonous style of speech and use formal language (G013)  
AND The expression on the child's face is less alive (G014)  
AND Children cannot start communication with people (G015)  
AND Children like to watch and play fingers in front of their eyes (G016)  
AND Children are sensitive to sensory stimuli such as feeling disturbed by bright light or closing their ears because they are disturbed by the sound of the environment |
THEN Asperger syndrome (P002)

**Rule 3**

IF Children often behave at risk without thinking about the consequences (G005)
AND Children's attention is easily distracted (G006)
AND Hyperactive children seem always excited and unable to be quiet and calm (G018)
AND Children are impatient (G019)
AND Children have difficulty following rules (G020)
AND Children often cut and interrupt people's conversations (G021)
THEN Attention and hyperactivity disorders (P003)

**Rule 4**

IF Children’s emotional state is unstable (G001)
AND Children cry or laugh without cause (G003)
AND Children cannot play with peers (G022)
AND Smallmouth, tongue protruding out and removing saliva (G023)
AND The nose looks flat (G024)
AND Children sometimes hit or bite friends (G025)
THEN Down syndrome (P004)

**Rule 5**

IF Poor children socialization ability (G002)
AND Children experience motor development that is slow, like being able to use an object (G004)
AND Children often behave at risk without thinking about the consequences (G005)
AND Children's attention is easily distracted (G006)
AND Children speaking ability is lacking (G008)
AND Children's expressive abilities are lacking (G027)
THEN Mental retardation (P005)

3.2 Designing UML with Use case diagram

Use case diagram is an abstraction from the interaction between the system and the actor. Therefore it is very important to choose suitable abstractions. The use case works by describing a typical actor interaction with a system with its own system through a diagram of how a system is used, such as figure 2 below:

![Figure 2. Use Case Diagram](image-url)
4 Result and Discussion

4.2 Main Page
This page is the start page that the user encounters when accessing the expert system of diagnosing a child’s growth disorder. On the main page there are several menus including the information menu, consultation menu, criticism menu and suggestions, and admin login menu, as shown in figure 3 below:

![Figure 3. Main Page](image)

4.2 Disruption Data Processing Page
The disturbance data processing page is used to process data interruptions such as added data interference, edit interference and delete interference data. To access the interference page, the admin can click on the submenu managing the disturbance data available on the admin menu, as shown in figure 4 below:

![Figure 4. Disruption Data Processing Page](image)

4.3 Rule Data Processing Page
The data rule processing page is used to process the data rule, the admin can click on manage data rule menu on the admin menu, as shown in figure 5 below:

![Figure 5. Rule Data Processing Page](image)
4.4 Consultation Page

The consultation page is a page for users to consult the system, by clicking on the consultation menu on the main page. Before being faced with a question, users are required to fill in the data first, as shown in figure 6:

![Figure 6. Consultation Page](image)

4.5 Patient Consultation Results Page

The consultation results page is the result given by the system to consultations carried out by users, as shown in figure 7: below:
5 Conclusion
From this research we can conclude some conclusion they are:

1. This expert system built can help users diagnose developmental disorders in children based on the symptoms chosen by the user when the consultation and system provides a general solution in the form of information about how parents should face child development disorders suffered by their child.

2. The application of an expert system for diagnosing disorders of child development can help and facilitate experts in giving the waiter consultation with patients effectively and efficiently.

3. By utilizing the MySql database, the expert system built is capable of storing expert knowledge representation based on bottom-up reasoning (forward chaining) and can save previous consultation data which is used as a benchmark for the following consultations.

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References
[1] Azmi, Zulfian dan Verdi Yasin. 2017. *Pengantar Sistem Pakar dan Metode*. Jakarta: Mitra Wacana Media.
[2] Gusman, A. P. (2017). Sistem Pakar Untuk Mendiagnosa Gangguan Autis Pada Anak Dengan Metode Forward Chaining. *Pendidikan Teknologi Informasi UPI-YPTK*, 2(1).
[3] Alhamidi, A. (2016). PERANCANGAN DAN IMPLEMENTASI SISTEM PENUNJANG KEPUTUSAN UNTUK MENDUKUNG PROSES PENYELEKSIAN SISWA BARU PADA SMAN 1 NAN SABARIS. *Jurnal Teknolof*, 4(2).
[4] Ermita. (2016). Analisis dan Perancangan Sistem Informasi Perpustakaan. *Jurnal Sistem Informasi (JSI)*, VOL. 8, NO. 1.
[5] Marlianda, L. (2015). Sistem Pakar Diagnosa Penyakit Kulit Pada Manusia Menggunakan Apotek Hidup Menggunakan Simple Additive Weighting. *Prosiding Semmasteck*.
[6] Putri, S. A., & Saputra, E. P. (2018). Perancangan Aplikasi Sistem Pakar Diagnosa Awal Kanker Reproduksi Wanita Dengan Metode Certainty Factor. *MEDIÀ INFORMATIKA BUDIDARMA*, 2(3).
[7] Septiana, L. (2016). Perancangan Sistem Pakar Diagnosa Penyakit Ispa Dengan Metode Certainty Factor Berbasis Android. *Jurnal Techno Nusa Mandiri*, 13(2), 1-7.
[8] Supartha, I Kadek Dwi Gandika dan Ida Nirmala Sari. (2014). Sistem Pakar Diagnosa Awal Penyakit Kulit Pada Sapi Bali dengan Menggunakan Metode Forward chaining dan Certainty Factor. *Jurnal Nasional Peridikan Teknik Informatika (JANAPATI)* Volume 3, Nomor 3.
[9] A.S. Rossa dan M. Shalahudin. 2014. *Rekayasa Perangkat Lunak Terstruktur dan Berorientasi Objek*. Bandung: Informatika Bandung.
[10] Abdulloh, Rohi. 2018. *Pemograman WEB untuk pemula*. Jakarta: PT Elex Media Komputindo.
[11] Kadir, Abdul. 2014. *Pengenalan Sistem Informasi*. Yokyakarta: ANDI Offset.
[12] Mandal, Eka Praja Wiyata. 2014. *Web Programming Project I*. Yogyakarta: Penerbit ANDI.
[13] Pratama, I Putu Agus. 2014. *Sistem Informasi Dan Implementasinya*. Bandung: Informatika Bandung.
[14] Republik Indonesia, Kementerian Kesehatan. 2014. *Pedoman Pelaksanaan stimulasi, deteksi dan intervensi dini tumbuh kembang anak ditingkat pelayanan kesehatan dasar*. Jakarta: Departemen Kesehatan RI.