Expert System for Diagnosing Early Childhood Developmental Disorders with Certainty Factor Method

Nandang Hermanto a,*, Zulfiqar Shertian Ramadhan a

aInformatics Engineering Study Program, Universitas AMIKOM Purwokerto, Central Java, Indonesia

Abstract

The purpose of this research is to design and build an expert system to diagnose the type of developmental disorder in children early using the certainty factor method. The method of data collection used in this study is observation, interviews, and library studies. The system was built with the Waterfall System Development Method. The stage of the Waterfall method is analysis, design, coding, and testing. This expert system is built using the PHP programming language and MySQL database. The result of this research was to successfully build an expert system to diagnose the type of developmental disorder in children early using the Certainty factor method to facilitate the user in diagnosing developmental disorders in the child quickly, efficiently, and without having to consult a pediatrician.

Keywords: expert system; certainty factor; children; Waterfall; website

1. Introduction

Each child will surely experience a growing period in his life. The childhood growth and development period are divided into four, namely the prenatal time of conception, the infancy of between 0-11 months, the period of children under 5 years (12-59 months), and the preschool period between 60-72 months. A child can be said to grow when the child has a change in the physical measured in quantity, while the development can be seen from the increased functions of the body more complex such as the ability of crude, smooth motion, speech and language, and socialization and independence[1]. If the child's mental growth is ripe then the child's emotion, thinking, and adaptation to the environment N will be good, but if the mental development is delayed, there will be a developmental disorder of the pervasive including Down Syndrom, mental retardation, Asperger Syndrom, Rett Syndrom, autistic and attention-centered and hyperactive disorder (GPPH) [2]. Children's growth takes place regularly, intertwined, and continuously starts from conception to adulthood. Although there are variations, each child will pass a specific pattern. Tanuwijaya describes the stages of growing children in two, namely prenatal and postnatal period. Each of these times has its characteristics and distinction in its anatomy, physiology, biochemistry, and character [3].

Several things can cause slow motor development. One of the causes of motor development disorder is muscular tonus disorder or neuromuscular disease. Children with cerebral palsies may experience limited motor development as a result of spasticity, athetosis, ataxia, or hypotonia. Spinal cord abnormalities such as spina bifida may also cause a delay in motor development. The neuromuscular disease Crate muscular Dystrophy shows a delay in walking ability. However, not always the disruption of motor development is necessarily based on the existence of the disease. Environmental factors, as well as child personalities, can also influence delays in motor development. Children who do not have the opportunity to learn as often carried may experience delays in achieving motor skills [4].

| No | Types of interference     | Age       | Amount                  |
|----|---------------------------|-----------|-------------------------|
| 1  | Mental retardation        | 4 years old | 10 Children and boys   |
| 2  | Passive autistic          | 3 years old | 4 Child                |
| 3  | Autistic hyperactivity    | 3.5 year  | 6 Children and boys    |
| 4  | Conduct Disorder          | 4 years old | 5 Children and boys    |
| 5  | Adhd                      | 5 years old | 8 Children and boys    |
Table 1 shows the number of children with personality disorders. In the table, the most number of sufferers are mentally disabled sufferers. It is increasing the number of developmental disorders in children up to approximately 15-20 per 10,000 children[5]. If the birth rate in Indonesia is 4.6 million children, the number of children with developmental disruption of other children will increase by 0.15% or approximately 6,900 children experiencing developmental Disorders (Source: depkes.go.id). Many parents late knowing the abnormalities or disorders of his son because of the ignorance of the parents regarding the symptoms, it is necessary to make a system to help the problem.

Health is a valuable thing for people because anyone can experience health problems. Lack of sensitivity to the symptoms of a disease is a fear of itself[13]. In the event of health problems, they are more trusted to experts or experts who know more about health, regardless of whether the disturbance is still low or chronic. However, with the ease with the presence of experts or expert doctors, sometimes there are disadvantages such as limited working hours and the number of patients who have to wait for the queue. In this case, more needs an expert who can facilitate the diagnosis of the disease earlier. So, they can be able to do early precautions that if it takes time if they consult with an expert doctor[6][14].

The expert system is an Artificial Intelligence (AI) program that combines a knowledge base with the engine inference. The Program acts as a smart consultant or advisor in a particular skill environment. The basis of the expert system is how to move the knowledge possessed by an expert into the computer, and how to make decisions or to make conclusions based on that knowledge. As a result of the set of knowledge that has been gathered from some experts. One of the areas of application that is quite prominent in the expert system is the diagnosis process. This diagnosis process can also involve medical action, such as conducting a diagnosis of the type of developmental disorders in children[7][15][16].

One implementation that applied the expert system in psychology, which is an expert system to determine the type of child developmental disorder. Children are the most vulnerable and very noteworthy phases, one step after another. To find out whether the child is experiencing developmental disorders or not, a diagnosis is much needed. Developmental disorders in children can be diagnosed with some of the behaviors shown by the child by observing a child psychology expert. In making decisions often, an expert/psychologist analyzes the information that exists with such phrases as possible, most likely or almost specific[8][9]. To overcome this, the expert system is designed to diagnose Developmental disorders in children by describing the level percentage. This expert system will make it easier for people in particular (parents) to diagnose developmental disorders in children without having to go and consult a doctor so that more efficient time and cost[10][11].

2. Research Methods

2.1. Data Collection

The method of collecting data is a method of an interview with the Posyandu Staff on developmental disorders in children and symptoms. The study also implemented a library study method to obtain references from books, journals, articles and other documents related to research.

2.2. System Development

Fig. 1 Waterfall Method

Fig. 1 is a waterfall system development method, in the Waterfall method, consists of 4 stages, namely analysis, design, coding and testing.
3. Results and Discussion

An expert system for diagnosing childhood developmental Disorders is one of the solutions used to diagnose developmental disorders of the child early on.

In this study, the method used was the certainty factor method with the forward chaining inference machine (forward trace), where by this method can determine a symptom based on the high value of certainty factor. The number of impaired children in this research is 5 types of disorders with 30 symptoms.

3.1. Child Disruption Data

Table 2 Data Developmental Impairment in Children

| Disease Code | Name of illness       |
|--------------|-----------------------|
| P01          | Mental retardation    |
| P02          | Passive Autistic      |
| P03          | Autistic Hyperactivity|
| P04          | Conduct Disorder      |

3.2. Symptom Data

Table 3 Data Developmental Disorder Symptoms in Children
(Source: Posyandu Healthy Children of Purwokerto)

| Symptom code | Symptom name                                             |
|--------------|----------------------------------------------------------|
| G01          | Brain capabilities are very less                         |
| G02          | Poor muscle coordination                                |
| G03          | Difficult to speak smoothly                             |
| G04          | Less expressive Facial                                   |
| G05          | Saliva often drips                                       |
| G06          | Slow learning and adapting                               |
| G07          | Avoid eye and physical Contact                           |
| G08          | Like to be alone                                         |
| G09          | Not much to talk                                         |
| G10          | Close away from others                                   |
| G11          | Not empathy for the conditions surrounding               |
| G12          | Often do Strange body language                          |
| G13          | Changing activities                                      |
| G14          | Do not care for others                                   |
| G15          | The movement is excessive                                |
| G16          | Very Active                                              |
| G17          | Communication Difficult                                 |
| G18          | Very hard to set                                         |
| G19          | Often angry and frightening others                       |
| G20          | Love starting a physical brawl                          |
| G21          | Glad to torture Animals                                  |
| G22          | Often use tools to threaten                              |
| G23          | Behave aggressively                                      |
| G24          | Not listening to advice                                  |
| G25          | Can not sit still                                        |
| G26          | Often cut/interrupt Activities people                    |
| G27          | Hard to be soothed                                       |
| G28          | Always act spontaneously without thinking                |
| G29          | Cannot Focus                                             |
| G30          | Can not control themselves                               |
3.3. Application Creation

Data flow planning aims to determine the process of information that flows through the software. To describe the design is commonly used tools such as the context diagram (context diagram) and the Data Flow Flow diagram (DFD).

**Fig. 2 DFD Context**

Entity Relationship Diagram (ERD) is a diagram used to design a database that shows the relationship or relation between an entity or an object involved with its attributes[12]. ERD Diagram of The expert system for diagnosis of children's developmental disorders, as shown below:

**Fig. 3 Entity Relationship Diagram (ERD)**

Fig 3 is the Entity-Relationship Diagram in the system of the early childhood diagnosis of children's developmental disorders with the certainty factor method.

3.4. System Implementation

a. Home page Application on expert systems

**Fig. 4 Expert System Home Page**
In Figure 4 is the main page of the root p system to diagnose early child developmental disorders with the certainty factor method.

b. Information page on the expert system

![Figure 5 Information Page]

In Figure 5 is the information page display on the root p system to diagnose child developmental disorders early with the certainty factor method.

c. Help page on expert systems

![Figure 6 Help Page]

Figure 6 is a help page display on the root p system to early diagnose child developmental disorders with the certainty factor method.

d. Admin Main Menu page on expert system

![Figure 7 Main Admin Menu]
In Figure 7 is the Admin main Menu page display on the root P system to diagnose early child developmental disorders with the certainty factor method.

3.5. Testing

| No | Access | Test class    | Test item       | Test Type |
|----|--------|---------------|-----------------|-----------|
| 1  | Admin  | Login         | Data Verification| Blackbox  |
| 2  | Admin  | Data Password | Change data     | Blackbox  |
| 3  | Admin  | Disease Data  | Change data     | Blackbox  |
| 4  | Admin  | Data Symptoms | Change data     | Blackbox  |
| 5  | Admin  | Relationship Data | Change data | Blackbox  |

4. Conclusions and Suggestions

4.1. Conclusions

From the results of research that has been done to the expert System of diagnosis of Developmental disorders in children, then it can be concluded as follows:

a. This research has been the result of designing and building an expert system capable of diagnosing Developmental Disorders in children using the Metode inference certainty factor.

b. Symptoms related to developmental disorders in children In this study has been successfully represented in the rule to be understood by computer systems.

c. Based on the results of testing using BlackBox Testing It can be concluded that all functions in This expert system successfully run.

4.2. Suggestions

On the development of this Expert system, researchers advise the following:

a. The development of expert system applications in Subsequent research is expected based on recent research by many experts.

b. Expert system development in Subsequent research is recommended for Android-based applications.

c. Implementation of system the next expert with a more excellent and responsive display design For example, with M Etro UI, because it has the essence distinctive and exciting.

References

[1] Charte F, Rivera AJ, del Jes´ us MJ, Herrera F (2015) Addressing imbalance in multilabel classification: Measures and random resampling algorithms. Neurocomputing 163:3–16

[2] Cheng W, Hullermeier E (2009) Combining instance-based learning and logistic regression for multi-label classification. Machine Learning 76(2-3):211–225

[3] Clare A, King RD (2001) Knowledge discovery in multi-label phenotype data. In: PKDD’01, Springer, pp 42–53

[4] Doquire G, Verleysen M (2013) Mutual information-based feature selection for multilabel classification. Neurocomputing 122:148–155

[5] Duda RO, Hart PE, Stork DG (2001) Pattern Classification, 2nd edn. New York: Wiley

[6] Furnkranz J, Hullermeier E, Mencia EL, Brinker K (2008) Multilabel classification via calibrated label ranking. Machine Learning 73(2):133–153

[7] Gibaja E, Ventura S (2015) A tutorial on multi-label learning. ACM Computing Surveys 47(3):1–38

[8] Hullermeier E, Furnkranz J, Cheng W, Brinker K (2008) Label ranking by learning pairwise preferences. Artificial Intelligence 172(16-17):1897–1916
[9] Kuncheva LI, Rodriguez JJ (2014) A weighted voting framework for classifiers ensembles. Knowledge and Information Systems 38(2):259–275

[10] Li P, Li H, Wu M (2013) Multi-label ensemble based on variable pairwise constraint projection. Information Sciences 222:269–281

[11] Liu H, Zhang S, Wu X (2014) Mlslr: Multilabel learning via sparse logistic regression. Information Sciences 281:310–320

[12] Liu H, Ma Z, Zhang S, Wu X (2015) Penalized partial least square discriminant analysis with 1-norm for multi-label data. Pattern Recognition 48(5):1724–1733

[13] Ma HP, Chen EH, Xu LL, Xiong H (2012) Capturing correlations of multiple labels: A generative probabilistic model for multi-label learning. Neurocomputing 92:116–123

[14] Montanes E, Senge R, Barranquero J, Ramon Quevedo J, Jose del Coz J, Huellermeier E (2014) Dependent binary relevance models for multi-label classification. Pattern Recognition 47(3):1494–1508

[15] Read J, Pfahringer B, Holmes G, Frank E (2011) Classifier chains for multilabel classification. Machine Learning 85(3):335–359

[16] Reyes OG, Morell C, Ventura S (2015) Scalable extensions of the relieff algorithm for weighting and selecting features on the multi-label learning context. Neurocomputing 161:168–182