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Expert System for Diagnosing Childhood Diseases with the Forward Chaining and Certainty Factor Methods based on Android

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Abstract:. Currently, many parents want their children to be free from disease. Although this cannot be fully expected. Problems that often occur to parents are when their child is sick, lack of knowledge and limited sources of information about the disease that causes parents to leave their children without first aid. In other conditions, in areas that are far from the doctor's practice, the need for information on disease management is very necessary. Based on the problems that have been described previously, this expert system was created to assist parents in understanding the symptoms of skin diseases that occur in children. In the development of this expert system using the Best-First Search (BFS) algorithm as an inference engine. In this expert system application the user can choose the symptoms of the disease in children, then the output produced is the conclusion of the disease. From the test results based on Blackbox, it was found that 100% functionality runs according to the list of system requirements. After this research was completed, it was concluded that to design an expert system in detecting childhood diseases, starting from conducting interviews, followed by system design, the next process was implementing the system, then testing by experts for compatibility with the data that had been obtained.

Keywords: Android; Certainty Factor; Child disease; Expert system; Forward Chaining.

INTRODUCTION

Children need to be considered for their health because their weak immune system makes them very vulnerable to germs, bacteria and disease. Often children have difficulty explaining their complaints, therefore parents are expected to be able to catch every body language of their children.

Diseases in children are very dangerous because diseases that attack children generally can lead to complications, to make a diagnosis of the disease, especially in children, careful examination is needed, even a pediatrician is needed. However, almost every region does not have enough pediatricians, so there are often delays in handling them.

Sei Pengtanganan Village, Panai Hilir Subdistrict, Labuhanbatu Regency, North Sumatra is a small village which is about 120 KM from the capital city of Labuhanbatu Regency (Rantauprapat) where the land route that must be taken to this village is minimal due to the lack of development from the local government. Even though it is categorized as the outermost and underdeveloped village, many users of gadgets such as cellphones and smartphones are used by the local community because in the last few years, gadget sales outlets have started to open in the village.

Expert systems are very helpful in diagnosing children's diseases. This has been proven by a number of previous studies. The results of research on an expert system with the application of the Certainty Factory method have been shown to be able to diagnose children with measles, rubella (Pujianti & Sitti, 2021). By applying the Dempster-Shafter method, the expert system is able to diagnose ADHD with an average success percentage of 90%, so it is very helpful for parents in diagnosing ADHD symptoms in children (Alkaff, Khatimi, Sari, Darmawan, & Primananda, 2019). By using the Forward Chaining algorithm, the expert system is proven to be able to diagnose diseases suffered by children, so that it can be used as a reference for parents in making decisions about children's diseases (Sari, Defit, & Nurcahyo, 2020). Meanwhile, by using the Besr-First Search method, the

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expert system can find the right solution to treat children's illnesses based on the symptoms experienced, where the solution given is the best solution (Angriani & Saharaeni, 2020).

Based on the background that has been described, the research aims to build an expert system that can diagnose children's diseases. The system is based on an Android application. In making this system the Best-First Search algorithm is applied. The formulation of the research problem is how to design an expert system to detect childhood diseases by applying the Best-First Search algorithm.

LITERATURE REVIEW

An expert system is a computer software that has a knowledge base for a specific purpose and uses reasoning that resembles an expert in solving problems (Darmayunata, 2018). Expert systems or knowledge-based systems are the most widely used in helping solve real-world problems (Ginting & RMS, 2018). This software can be run once by a personal computer device, so that artificial intelligence applications can be done easily and at a relatively cheaper cost (Efendi & Sari, 2020).

The Diagnostic Expert System is used to search for problem solving or damage to a certain tool or machine (Ferdiansyah, Muflikhah, & Adinugroho, 2018). This system is the most popular type of expert system today, performs a diagnosis, uses a description of the state of behavioral characteristics, or knowledge of component manufacture so that it can determine possible damage to the system (Kurniawan, 2018).

The Best-First Search (BFS) algorithm is a combination of the Depth First Search algorithm and the Breadth First Search algorithm by taking the advantages of both (Chen, He, He, & Chen, 2018). In the Hill Climbing algorithm, the search process is not allowed to return to a node at a lower level even though the node at a lower level has a better heuristic value (Więckowski, Kizielewicz, & Kołodziejczyk, 2020). In the BFS algorithm, the search process is allowed to visit the node at the lowest level if the highest level has a worse heuristic value (Chimanga, Kalezhi, & Mumba, 2016).

METHOD

Broadly speaking, the Pediatric Disease Expert System designed using the Best-First Search method aims to facilitate the work of doctors/health workers who have difficulty in diagnosing child diseases. The flow of the stages in this research can be seen in Figure 1.

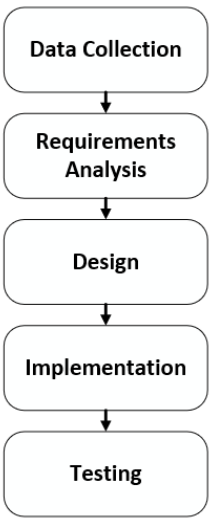

Fig 1. Research Framework

Data Collection

The data used in this expert system was obtained from a direct expert, namely Mrs. Siti Jumiah, a health worker who has served for 20 years in healing children and mothers. This system runs on Smartphones because currently there are more Smartphone users than Personal Computer users. This Expert System only contains diseases that are common in children and need easy treatment.

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Requirements Analysis

User needs (users) are emphasized on system users, namely doctors or health workers who have permission to diagnose diseases. Pediatric Disease Expert System Provides a symptom that can be compared with the child's condition, the symptoms displayed by the system are general symptoms not symptoms that must be further examined to find out, the results of the diagnosis will be displayed if the existing symptoms have been selected, the results of these symptoms will be displayed. given in an account, by using the Best First Search method, the user does not need to take too long in sorting out the existing diagnoses.

Table 1. Base Knowledge

Penyakit	Gejala	Bobot	Total
Demam	Berkeringat pada malam hari	25%	100%
	Tubuh terasa lemas	25%	
	nafsu makan berkurang	25%	
	tubuh panas	25%	
Pilek	Berkeringat pada malam hari	20%	100%
	Tubuh terasa lemas	20%	
	Bersin bersin	20%	
	hidung tersumbat	20%	
	hidung berlendir	20%	
Diare	Pusing	33.33%	100%
	sering BAB	33.33%	
	BAB nya encer/mencret	33.33%	
Muntah Muntah	terlalu banyak makan	33.33%	100%
	makan makanan yang baru	33.33%	
	mual mual	33.33%	
Cacar Air	pusing	20%	100%
	sakit perut	20%	
	mengigil	20%	
	muncuk bintik merah	20%	
	gatal gatal	20%	
Batuk	Berkeringat pada malam hari	33.33%	100%
	tenggorokan kering	33.33%	
	sering mengeluarkan suara uhuk uhuk	33.33%	

Design

The system is designed using the Unified Modeling Language (UML) modeling language which includes, Use Case Diagrams, Activity Diagrams, Class Diagrams, etc..

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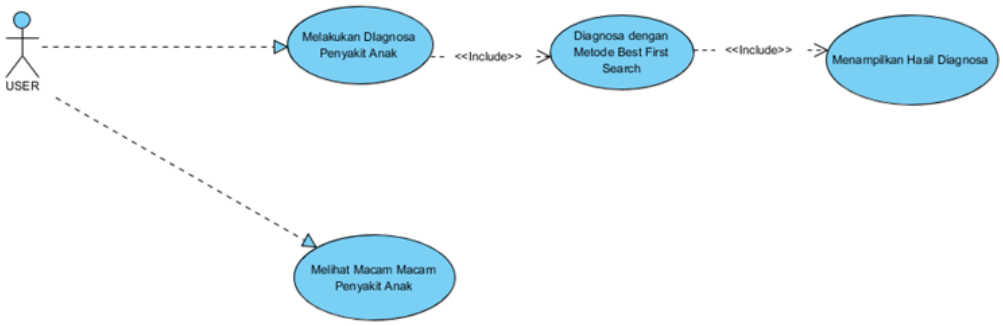

Fig 2. Use Case Diagram

Users are users who diagnose children's diseases and can view information on the types of children's diseases. Users can access the diagnostic menu by pressing the diagnostic button. After that, select the symptom according to the child's condition, then the system will provide a diagnosis result in the form of the child's disease.

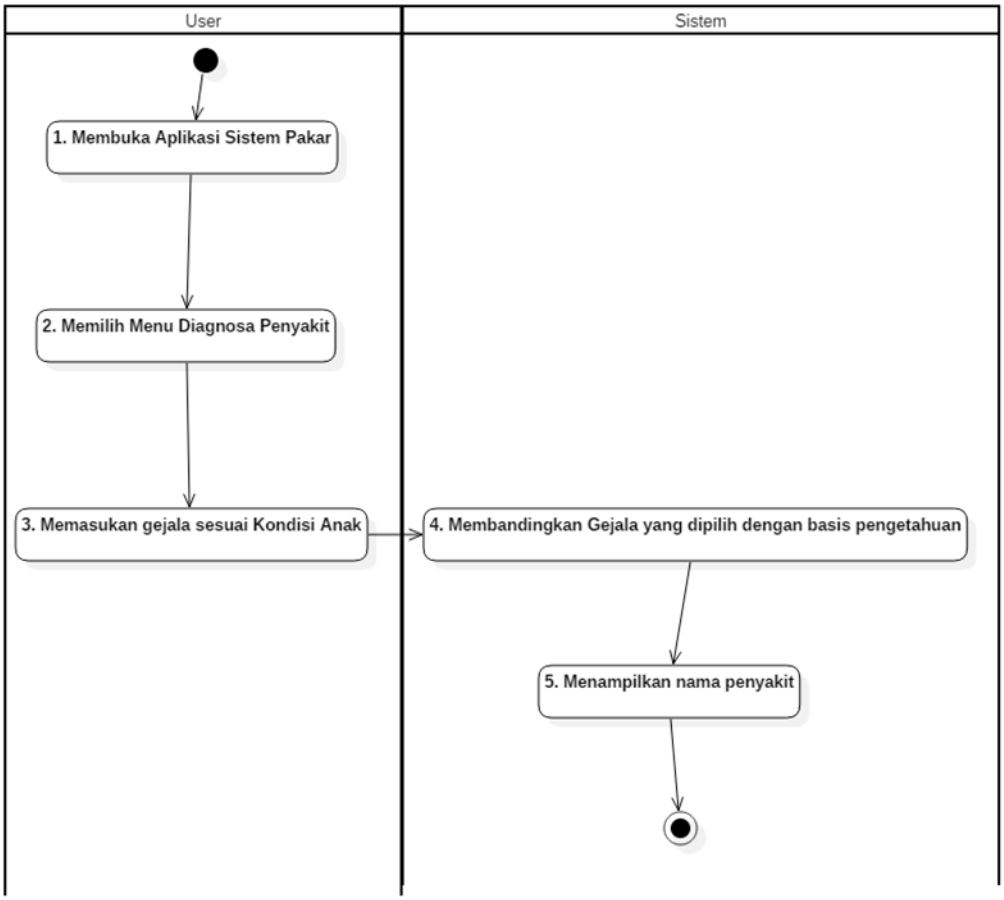

Fig 3. Activity Diagram

The activity diagram in Figure 3 is a diagram that explains the diagnostic flow in the system starting from the first symptoms until the disease appears by the system.

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Implementation

The implementation stage is the process of converting the system design into program code. Writing program code using the Java and PHP programming languages. Programming is done using IDE Visual Studio Code and Android Studio.

Testing

The tests that will be used are Black Box testing and Accuracy testing.

RESULT

In this system there are 6 diseases that are very common in children throughout Indonesia. Diseases that commonly attack children can usually be cured if the child gets enough rest and gets treatment by the family.

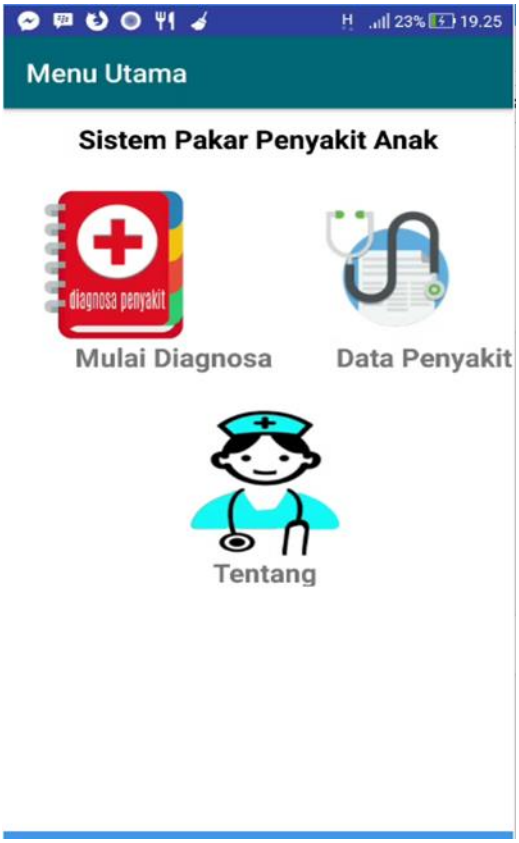

Fig 4. Main Menu Page

Figure 4 is the main menu which is the initial menu when you first run the pediatric disease expert system application. In the diagnostic menu, the user is asked to select symptoms according to the child's condition, which if pressing YES or NO will change the symptoms according to the Best First Search method. From the results of the diagnosis made by the user, it will provide a conclusion in the form of a diagnosis result to display the name of the disease from the symptoms that have been selected by the user. In addition, there is also a disease list page which, if selected, will display the names of diseases recognized by the system. As shown in Figure 5 below.

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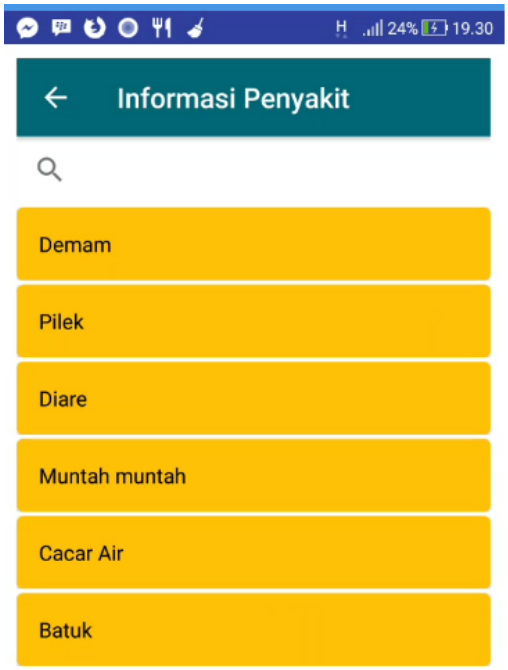

Fig 5. Disease List Page

The disease diagnosis trial will select several different symptom options 3 times to compare each percentage result. The first attempt when doing the diagnosis only chose the YES option 3 times. In the Second Experiment, you chose NO 2 times and then continued by selecting YES until the diagnosis was complete. For the last experiment, a diagnosis was made by pressing YES for the first symptom, then NO for the second symptom, and YES again for the third symptom and NO for the fourth symptom and so on so as to get the diagnosis result, as shown in Figure 6 below.

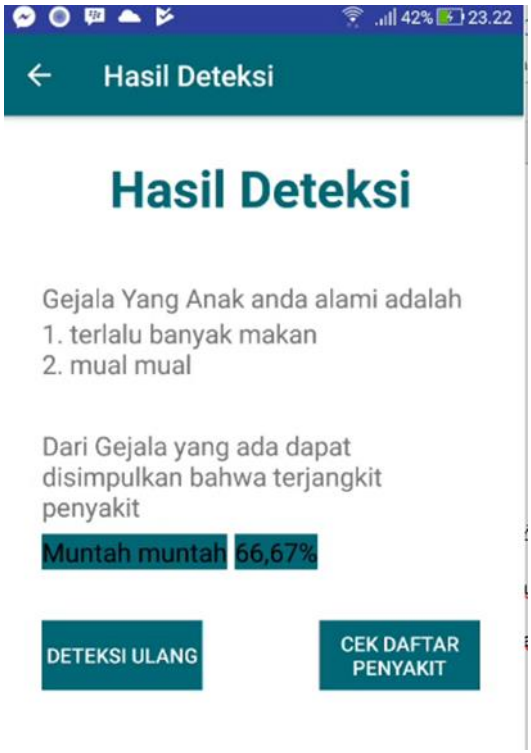

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Fig 6. Diagnostic Results on Application

Table 2. Blackbox Testing Results

Nama Pengujian	Kondisi Pengujian	Harapan	Hasil
Halaman Diagnosa	Memilih ya pada saat diagnosa	Ketika pengguna memilih YA maka akan dilanjutkan ke gejala sesuai pohon keputusan	Valid
Halaman Diagnosa	Memilih tidak pada saat diagnosa	Ketika pengguna memilih Tidak maka akan dilanjutkan ke gejala sesuai pohon keputusan	Valid

From the Blackbox Testing Results, it was found that the pediatric disease expert system was successfully running according to the Best-First Search method, as seen from the fact that no errors were found when testing from the Blackbox Testing side..

DISCUSSIONS

The Best First Search method in designing an expert system for pediatric diseases divides the symptoms into a Node Level where Level 0 has not started, the symptoms that have the most disease are Symptoms with Disease Codes G011, G001 and G014 because they have more than 1 disease so they enter the Node Level 1, then the next search is a search by looking at the decision tree as shown in the symptom table which has fields, namely YES, NO, START and DONE.

The Yes field has a Value which is the Symptom Code when the User presses YES, for example Symptom G011 in the YES FIELD has a Value of G012 then the next diagnosis will display symptoms from the G012 code. DOES NOT contain a symptom code value when the user in conducting a diagnosis selects NO, the next symptom that is displayed Symptoms with a Code according to the Value in the No field, for example G011, in the field DOES NOT have a symptom code value G001, then when the user selects it will not proceed to the symptom G001 Start is Field is a field to determine which symptom code will be displayed at the beginning of the diagnosis, here G011 is the initial diagnosis, therefore only symptoms with code G011 whose starting value is "Y". Finish is the final field, so when the diagnosis reaches the node where it has symptoms that have the completion value field is "Y" then the diagnosis is complete, it continues to the diagnostic results page.

The percentage result for each disease is determined from how many in 1 disease store how many symptoms, the number of symptoms according to the decision tree and also the weighting for example Cold Disease in the decision tree there are 5 symptoms and in the table the weighting of 1 Symptom is worth 20% so for diagnosis only choose 4 symptoms 80% results appear with the name cold disease, to display which disease will be displayed is the disease with the highest percentage, for example the user selects a symptom which was originally in Disease A but at the end of the diagnosis it turns out to choose many disease B then the diagnosis results only show symptoms of disease B and produces a percentage of disease B only.

CONCLUSION

Based on the results of the analysis and trials that have been carried out, it can be concluded that to design an expert system in detecting children's diseases, it starts from conducting interviews with experts to obtain data about diseases and symptoms that often attack children aged 5-10 years, from the data obtained is then continued with system design, if the design has been completed, then the next process is the implementation of the system, for further testing by experts for compatibility with the data that has been obtained.

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