

# A Proposed Model Expert System for Disease Diagnosis in Children to Make Decisions in First Aid

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**Abstract**—Children have a weaker immune system than adults. They are susceptible to disease. Therefore, this study proposes an expert system model of disease diagnosis in children. We develop expert strategies to meet the needs of alternative diagnostic tools in making decisions and first aid for children suffering from illness. The development of an expert system model for diagnosing children's diseases using forwarding chaining based on If-Then as an inference engine. We chose the forward chaining method because it has a framework for thinking like a doctor's when diagnosing and concluding the disease. We made testing to model by doctors with 35 patients. The test results show that the expert systems model of disease diagnosis in children in this research has to be used as an alternative or comparison diagnostic tool with an accuracy rate of 79%.

**Keywords**— expert system; forward chaining; children; diagnosis of disease

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## I. INTRODUCTION

The age most susceptible to disease is the age of children [1]. The condition that attacks children is prevented with prompt treatment. Therefore, we need an alternative diagnosis that is fast and proper for handling and preventing diseases in children when required. Expert systems as part of artificial intelligence are an alternative solution. An expert system is a skill taught to a computer by an expert. This information is then saved on a computer. When a user asks the computer for information, the expert system requests facts and then uses reasoning (inferences) to get a conclusion. The expert system then delivers an explanation (drawing inferences based on the prior consultations' outcomes).

Artificial intelligence is a part of computer science that is programmed to work according to its programming, which is to do humanitarian work and potentially even better [2]. Intelligent systems are built with the rules of artificial intelligence, including expert systems. Expert systems are smart computer programs that use an expert's knowledge and inference procedures to solve a complex problem and produce solutions for them [3] [4]. Expert systems have two components: the knowledge base and intelligent machines [5]. The knowledge base is the core of expert systems, and smart machines are the driving force.

The application of expert systems has been developed to detect a disease. The research was conducted using the forward chaining method [6]. The expert system designed in this research group aims to diagnose the condition of children under five and use data drawn from interviews with doctors. The resulting expert system application has an average accuracy rate of 80% when diagnosing diseases. His study mentioned that expert systems could be used as an alternative diagnosis.

Different sources say similar studies [7] - [2] develop expert systems using the forward chaining method and use data derived from expert interviews. The expert system is used for more specific diagnoses of childhood diseases, skin, and mental disorders. His research resulted in applications that could read and analyze studied conditions more easily.

Based on a literature study of previous research that has variables about children, the focus of research examining common diseases in children has not been adequate. Therefore, this study focuses on diagnosing the symptoms of common diseases in children. The research aims to develop an expert system model for diagnosing common disorders in children. This research is essential to produce tools that help diagnose diseases in children from symptoms given as alternative diagnoses by doctors.

## II. RESEARCH METHOD

The data used to develop the model in this study came from interviews with doctors as experts. The results of the discussion found that about 25 common diseases affect children. Meanwhile, model development is done by the Waterfall method. System development is carried out with stages of data collection, analysis, design, construction, testing, and evaluation activities.

In this research, data collection was carried out from medical guide books and interviews with doctors as experts. The data collected is analyzed to be used to develop expert system models. The expert system model is designed in the form of use case salt; the construction of the system is done in PHP and uses MySQL for its database. Testing activities are carried out by the black box testing approach [6] [8]. In the end, an evaluation is conducted to determine the accuracy of the resulting model.

### A. Forward chaining

Forward chaining is a system of inference that starts from several known facts—from the premise or input (If), which contains the facts, and then concludes with one or several conclusions (Then). Forward chaining starts from finding some points and applying rules to determine all possible findings [3] [9] [10], as illustrated in Fig 1.

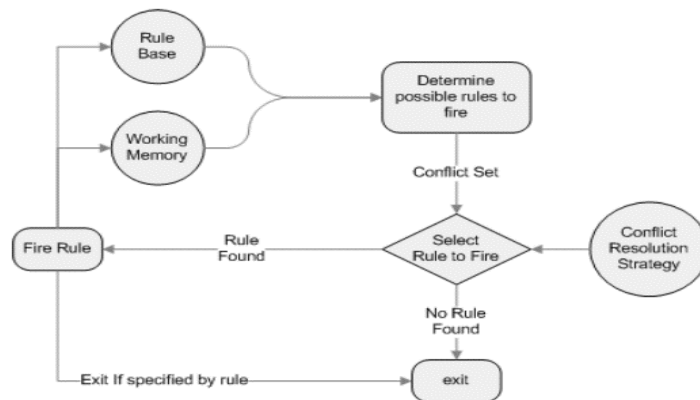


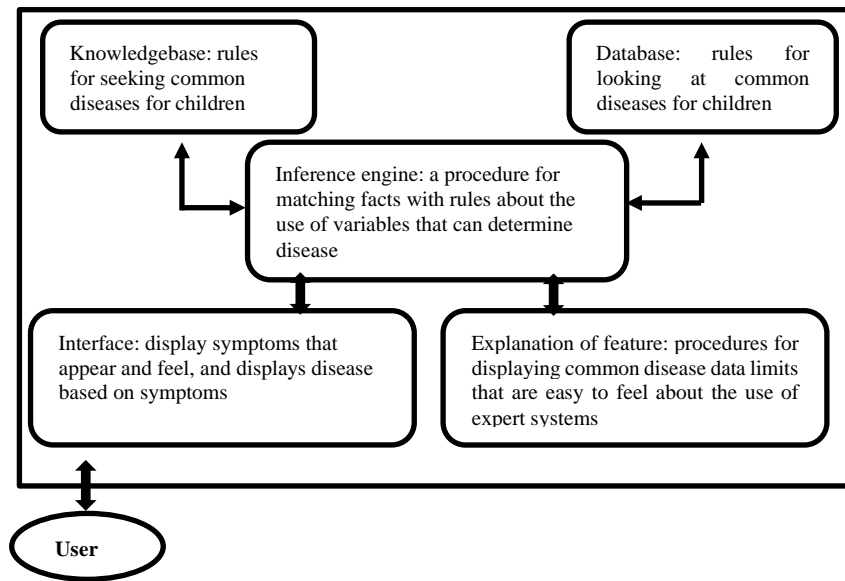
Figure 1. FLOWCHART OF FORWARDING CHAINING

### B. Analysis of data

The data used in this study were obtained from primary and secondary sources. Data were analyzed to compile the ruse base needed on the developed system. Furthermore, the data is sorted and filtered to determine the data into facts (If) and conclusions (Then). This analysis is done to make the design of the system developed.

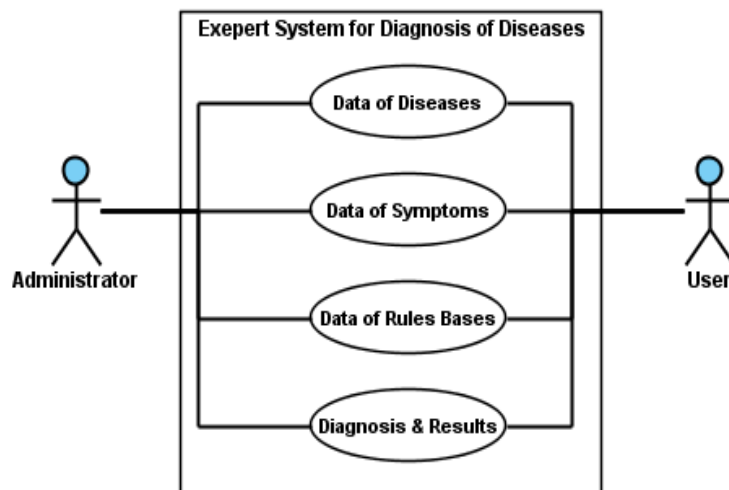
The search technique used in the expert system developed in this study is to find several solutions that originate from more than one diagnosis as a problem solving or indication of an indication submitted by the end-user. The selection of search techniques in diagnosing childhood

illnesses is carried out because it can provide a solution to be considered in the differential diagnosis of diagnosing common diseases in children [11].



**Figure 2.** FLOW AND ARCHITECTURE OF AN EXPERT SYSTEM (PROPOSED)

The expert system of diagnosing diseases in children in this study was designed based on the needs of the components of the system. The flow system adopted research detecting ears, nose, and throat disease [12]. The adoption is in the knowledge base and database blocks, as shown in Fig 2. However, the knowledge base developed in this study is different.



**Figure 3.** USE CASE OF EXPERT SYSTEMS FOR DIAGNOSIS DISEASES (PROPOSED)

Data processing is a hardware component that enables people to turn data into a computer that can then be processed using the software. The data processing process comprises one entity,

Admin, and four data processing processes, including data processing for Data of Diseases, Data of Symptoms, Solutions, Data of Rules Bases, and Diagnosis & Results.

The functional system diagnosis model in children has functionally illustrated, and the use case diagram form in Fig 3. This study proposes an operational model as a use case diagram for users.

### **C. Knowledge Base**

Knowledge-based representation of knowledge as a basis for solving problems commonly used by machine learning. The expert knowledge base is generally used to support decision-makers from the results of the search for facts. In designing an expert system of disease diagnosis in children in this study, the knowledge base representation is called rule-based and written in the form of statements [13] [14]. This representation is intended to capture the problem of essential property and make the information accessible to problem-solving procedures. In this study, the model of a rule base structure in the forward chaining method is as follows [15].

If Condition 1

And Condition 2

And Condition 3

And Condition 4

Then Conclusion

## **III. RESULT AND DISCUSSION**

### **A. Knowledge Acquisition**

Knowledge entities in the developed system consist of diseases, problems, statements, and explanations. One condition can have several issues, while one problem has only one idea. One disease can have several words, one solution, and one resolution. At the same time, the knowledge base consists of facts and rules. Points are obtained from knowledge and expertise in the field of disease. In this study, the symptoms experienced by children were identified and discovered through interviews. Meanwhile, to find out complaints and symptoms experienced by children, questions and answers are usually done by their parents, physical examination, and other sources.

### **B. Making of Rules**

The data and facts obtained from the source changed into rules based on 25 diseases. Based on data and facts from the 25 diseases produced 81 rules. The rules are made based on expert knowledge. The list of disease symptoms used in making the rules in this study is in Table 1.

**Table 1. THE SYMPTOMS**

<b>Code</b>	<b>Symptoms</b>
G01	Fever
G02	Malaria
G03	Headache
G04	High Fever continuously 2-7 days
G05	Decreased appetite
G06	Weak, tired, and lethargic
.....	.....
G81	History of being bitten by an animal

The data in Table 1 are the symptoms experienced directly in the patient's body and the physical appearance symptoms of the patient. At the same time, the types of diseases are in Table 2 and the rules in Table 3.

**Table 2. LIST OF DISEASES**

<b>Code</b>	<b>Diseases</b>
P01	Varicella (Chicken Fox)
P02	Food Allergy
P03	Dengue Fever
P04	Typhoid Fever
P05	Hepatitis A
P06	Parotitis / Maps
P07	Conjunctivitis
P08	Eye Chemical Trauma
P09	Foreign Object in the Ears
P10	Serum Prop
...	.....
P25	Urinary tract Infection

**Table 3.** RULES OF DISEASES SYMPTOMS

Rule	If	Then
01	IF G01 AND G045 AND G055	P25
02	IF G01 AND G02 AND G056	P01
03	IF G05 AND G01 AND G07 G16	P03
04	IF G03 AND G05 AND G06 AND G08	P04
05	IF AND G01 AND G64 AND G65 AND G66 AND G05 AND G16 AND G06	P05
06	IF AND G69 AND G70 AND G71 AND G20 AND G22 AND G21	P08
.....		
25	IF AND G01 AND G72 AND G35 AND G74 AND G34 AND G12	P14

### C. System Implementation

The expert system implementation of disease diagnosis in children was developed using PHP, MySQL, and desktop-based databases. The SQL database is used to store the output of the application. The use of databases in this study adopted a business intelligence approach [18]. The results of implementing the developed system are shown in Fig 4, Fig 5, and Fig 6. Figure 4 illustrates the symptoms and diagnosis. Figure 5 shows the diagnosis result in the model of an expert system for disease diagnosis in children to make decisions in the developed first aid.

**Figure 4.** FORM DATA OF SYMPTOMS AND DIAGNOSE

Symptoms and consultation forms are used to view signs—easy-to-use features and talk.

Disease	Varisela
Disease info	The main cause of chickenpox is the varicella zoster virus, which is characterized by the appearance of a rash on the skin as the main symptom. The rash turns into a red, itchy, fluid-filled rash which then dries up, scabs, and peels within 7 to 14 days.
Disease Solution	-Drink lots of drinking and eat soft foods. -Don't scratch the chickenpox rash or wound. -Wearing soft and light clothing. -It is advisable to get chickenpox vaccination

**Figure 5.** FORM DIAGNOSE OF DISEASE KNOWN

Diagnostic form/consultation results, this feature is used for consultations that can be used by experts and patients who have symptoms and then suppresses the diagnosis. The system will analyze and match the symptoms with the rules; if by following the rules, the expert system will display the results of the disease diagnosis on the screen.

Disease	Not yet known
Disease info	No information was found regarding the symptoms you entered, due to our limited data
Disease Solution	Please do further examination through a doctor

**Figure 6.** FORM DIAGNOSIS OF DISEASE UNKNOWN

If you do not follow the rules, the system will repeat until it finds another type of disease that matches the rules.

#### D. System Testing and Evaluation

Testing is done to determine how well the expert system's performance was developed. The test was carried out using 35 patient data. Testing is done using a scenario approach [19]. This approach is used by conducting several tests using several data sets. The results of testing the system are shown in Table 5.

On the other hand, an evaluation of the system is done to find weaknesses in the developed system. The successful assessment must be concurrent, analytical, and thorough analysis can solve the problem [16]. In this study, testing of this system was conducted using 35 respondent data. The test results show that the model expert system for disease diagnosis in children to make decisions in first aid, which develops in this research, has an average accuracy of 79%.



The result happened because the expert system diagnoses only one disease from the rules (symptoms) that have been determined. At the same time, the Doctor of the symptoms mentioned can suspect two or three conditions in the symptoms mentioned. The results of this study reinforce research [15] [17] [6] [1] that an expert system can be used as an alternative material for making decisions.

**Table 5. RESULT OF THE SYSTEM TESTING**

Data	Symptoms experienced	Diagnose by System	Diagnose by Doctor	Accuracy (%)
Data 1	Fever, Malaise, Lump with water	Varicella (Chicken Fox)	Varicella (Chicken Fox)	100%
Data 2	Malaise, Vomiting, Whole body bums after eating seafood	Food Allergy	Food Allergy	100%
Data 3	Decreased appetite, Fever, Nosebleeds or bleeding from holes in the body, Aches/Muscle Aches	Dengue Hemorrhagic Fever (DBD)	Dengue Hemorrhagic Fever (DBD)	100 %
Data 4	The Fever rises in the afternoon and evening, Headache, Reduced appetite, Tired and lethargy, Nausea	Typhoid fever	Typhoid fever	100%
Data 6	Fever, Yellow eyes and skin, Urine like tea, Feces like putty, Decreased appetite, Aches/Muscle aches, Weakness, Fatigue, and lethargy	Hepatitis A	Hepatitis A	100%
Data 7	Fever, Malaise, Decreased appetite, swelling in the area of the front ear to the lower jaw, Pain if chewing.	Mumps	Parotitis/ Mumps	50%
Data 8	Red eyes, Pain in the eyes, History of exposure to chemicals in the eyes, Blurred vision, Pain in the eyes, Difficult opening the eyes	Eye chemistry	Eye chemistry	100%
.....	.....	.....	.....	.....
Data 35	Shortness of breath, nasal congestion, tightness worsening due to make, changes in weather	Asthma	Asthma Acute bronchitis	50%
Average accuracy level				79%

#### IV. CONCLUSION

This research has produced an expert system model of disease diagnosis in children to make decisions in first aid with an accuracy rate of 79%. This shows that the application of expert systems has quite a high accuracy. However, the expert system produced in this study cannot be used as a primary or primary diagnostic tool but rather as a comparative or alternative diagnosis. The expert system model created can be used if you need a fast diagnosis and if the intended Doctor is unable for other reasons. This expert system model is used to make decisions in first aid.

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