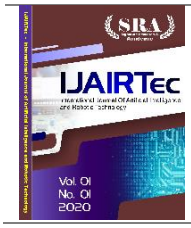

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DESIGN OF AN EXPERT SYSTEM FOR THE DIAGNOSIS OF TUBERCULOSIS (TBC) USING THE VISUAL BASIC FORWARD CHAINING METHOD

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Abstract
One of the infectious diseases that is currently still a global concern is Tuberculosis or what is often called TB. Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis. Making this expert system aims to produce a system that is capable of making a diagnosis that can provide a quick and accurate decision for tuberculosis sufferers with ease of use and provide solutions/suggestions according to the type of TB disease. The method used in this study uses the forward chaining method, which is an inference method that does reasoning from a problem to its solution. If the premise clause matches the situation (values TRUE), then the process will state the conclusion. The implementation of this expert system program goes well and provides the right solution for users.

I. INTRODUCTION

Health is a very important need in the life of every human being, namely a state of well-being of body, soul and social that allows everyone to live productively socially and economically. Meanwhile, various diseases are often easily attacked when a person is not taking good care of his health. Infectious diseases are diseases that are dangerous for anyone, whether they have strong immune systems or even weak ones, because they can spread quickly through air, touch, or other means. One of the infectious diseases that is currently still a global concern is Tuberculosis or what is often called TB. Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis. Tuberculosis usually attacks the lungs, but can also affect other parts of the body [1]. Based on data from the World Health Organization (WHO) in 2015, there were still 10.4 million cases of TB in the world, an increase from previously only 9.6 million. The largest number of TB findings were in India with 2.8 cases, followed by Indonesia with 1.02 million cases and China with 918 thousand cases. Indonesia is a country with the second largest TB sufferer in the world. This number consists of 5.9 million (56%) men, 3.5 million (3.5%) women, and 1 million (10%) children [2]. The

development of TB disease is so fast, while many people do not understand the symptoms of this disease, the government has also made efforts to suppress the evolution of TB disease, but the results are not in accordance with the predetermined targets.

With this condition, an expert system was created to prevent it from an early stage as a substitute for experts to diagnose TB on a visual basis so that it could be used by anyone. Basically, this system is taken from the knowledge of a human being who is an expert in the domain and tries to imitate its methodology and performance [3]. With the existence of an expert system based on Visual Basic, it will make it easier for people to diagnose whether the person has TB symptoms or not. To support the expert system so that the results are more accurate, this expert system is made using the forward chaining method. By entering the variables of the symptoms experienced by a person and producing the right treatment solution. This expert system can later reduce the number of people with indications of more severe TB disease, thereby suppressing the evolution of TB disease.

II. LITERATURE REVIEW

2.1 Tuberculosis (TB)

Tuberculosis or TB is an infectious disease caused by the bacterium Mycobacterium tuberculosis. TB disease primarily attacks the lungs. The lungs are very fragile organs (lung bubbles) so that if you get TB, a hole (caverne) can form in the lungs. When the disease gets worse, the patient is thinner, pale, very weak, and coughs up blood. Sometimes there is even bleeding because of the severing of a large blood vessel in the lung. Apart from attacking the lungs, TB can also attack the kidneys, bones, intestines, liver, lymph nodes, brain and others. TB is also one of the oldest diseases known to affect humans. If treated properly TB disease caused by the Mycobacterium tuberculosis complex, which is sensitive to drugs, can be practically cured. Without tuberculosis therapy will result in death within the first five years in more than half of cases.

This disease is a big problem for developing countries including Indonesia, because it is estimated that 95% of people with this disease are in developing countries, and 75% of people with this disease are in the productive age group (15-50 years) [4].

2.2 Expert system

The expert system is a fairly old branch of Artificial Intelligence (AI), because this system was developed in the mid-1960s. The expert system that first appeared was the General-Porpose Problem Solver (GPS) developed by Newl and Simon. Until now, many expert systems have been made, such as Mycin, Dendral, Xcon & Xsel, Sophie, Prospector, Folio, Delta, and so on [5].

In general, an expert system is a system that adopts human knowledge into a computer so that the computer can be used to solve a problem as an expert does. More specifically, an expert system is a system that is designed and implemented with the help of a particular programming language to be able to solve certain problems as done by experts. This system allows ordinary people to solve certain problems, whether slightly complicated or complicated, even without the help of experts in that field. As for experts, expert systems can be used as experienced assistants.

A system can be said to be an expert system if it has the following characteristics.

1. Limited to a certain domain of expertise
2. Can provide reasoning for uncertain data
3. Can explain the series of reasons given in a way that can be understood
4. Based on certain rules or rules
5. Designed to be developed in stages
6. The output or output is recommended.

A system created to solve problems like an expert must be able to do things that an expert can do. So, to build a system like that, at least the system must have the basic components, including the following:

1. User interface (User interface)
2. Knowledge Base
3. Inference engine

Meanwhile, to make the expert system more like an expert attack that interacts with the user, it can be equipped with the following facilities:

1. Facility explanation (Explanation)
2. Knowledge acquisition facility
3. Self-training facilities [6].

2.3 Forward Chaining

Forward chaining is an inference method that does reasoning from a problem to its solution. If the premise clause matches the situation (values TRUE), then the process will state the conclusion. Forward chaining is data-driven because inference starts with available information and new conclusions are obtained.

Forward Chaining can also be called matching facts or statements starting from the left side (IF first). In other words, reasoning starts from the facts first to test the truth of the hypothesis [6].

2.4 VisualBasic

Microsoft Visual Basic (often abbreviated as VB only) is a programming language that offers a visual Integrated Development Environment (IDE) for creating software programs based on the Microsoft Windows operating system using a programming model (COM). Visual Basic is a derivative of the BASIC programming language and offers fast graphics-based computer software development.

Some of the capabilities or benefits of Visual Basic, including:

1. To create Windows-based application programs.
2. To create ActiveX, Internet Applications and so on.
3. Testing the program (debugging) and producing the final program ending in EXE which is executable or can be directly executed [7, 8].

III. RESEARCH METHODS

3.1 Data Collection Methods

In conducting this research, several data collection methods were used as the first step in gathering information in system development, namely:

1. Literature study, which is a method that is carried out by reading books, journal articles and previous research that has been carried out by researchers that can support the process of completing work.

2. The interview method is a conversation between the researcher and the informant. Researchers here hope to get information, while the informant is assumed to have important information about TB disease.
3. The observation method is a research method where researchers make observations about all activities in the form of phenomena found in the field, in order to support the interview results with the intention of providing solutions through an information system that will be built so that it can be more useful.

3.2 Analysis of Data Needs

A system that is designed to be able to process problems requires analysis to determine the process of running the system. To find out the problems and needs in system design, it is necessary to analyze the data that has been done in the previous data collection. Some of the data needed to start making the system is as follows:

1. Disease Data, disease data contains information about the type of TB disease.
2. Symptom data, symptom data is needed to determine the type of TB disease. This data will provide information about the symptoms of the disease in the sufferer who will be diagnosed by the system.
3. Solution Data, solution data for each type of disease to provide solutions or treatment suggestions.

3.3 Tracking Process

The tracking process used in this system follows the Forward Chainning pattern . In the identification of TB disease, the forward tracking process begins by asking questions about which symptoms the patient is experiencing , then from the entered symptoms a diagnosis will be obtained about the type of TB disease being suffered and the solution for handling it .

3.4 Knowledge Representation

In this study the knowledge base is represented using IF-THEN. For example: if you **cough for a long time** and **shortness of breath** and **night sweats** …... **N** then **diagnosis:** pulmonary tuberculosis (type of disease), followed by information on solutions and how to deal with them .

Knowledge base of the types of TB disease that will be detected by the system which includes the code and name of the disease. Some of the data on the type of disease in TB disease needed to start making the system are as follows:

P1: Pulmonary TB disease.
P2: Glandular tuberculosis.
P3: Bone TB disease.
P4: Miliary TB disease.

Meanwhile, the knowledge base for TB symptoms is as follows:

G1: Cough with phlegm.
G2: Coughing up blood.
G3: Long cough.
G4: Shortness of breath.
G5: Body limp.
G6: Decreased appetite.
G7: Weight loss.

G8: Night sweats.
G9: Old fever.
G10: Chest pain.
G11: Uneasy feeling (malaise).
G12: Decreased consciousness.
G13: Mild cough.
G14: Enlarged spleen.
G15: A lump appears on the neck.
G16: A lump appears in the armpit.
G17: A lump appears between the thighs.
G18: Body aches and tired in the afternoon.
G19: Pain in the joints of the bones.
G20: Swollen bones.
G21: Restricted movement.
G22: Bluish-red skin.
G23: The skin over the affected area feels hot and sometimes cold.

So that the decision table can be made as follows:

Table 1. Decision on determining TB disease

TB SYMPTOMS CODE	**TB TYPE CODE**			
	P1	**P2**	**P3**	**P4**
G1	■			
G2	■			
G3	■		■	
G4	■			
G5	■			
G6	■	■	■	■
G7	■	■	■	■
G8	■	■		■
G9	■	■	■	■
G10	■			
G11	■		■	
G12		■		
G13		■		
G14		■		
G15			■	
G16			■	
G17			■	
G18				■
G19				■
G20				■
G21				■
G22				■
G23				■

The solution knowledge base for TB disease, contains solution data or suggestions for TB disease consisting of solution codes, disease codes and solutions. Some data on types of TB disease and the solutions needed to start making this system are as follows:
S1: P1: The solution for pulmonary tuberculosis.
S2: P2: Solution for glandular tuberculosis.
S3: P3: Solution for bone tuberculosis.
S4: P4: Solution for miliary tuberculosis.

3.5 System Development

In carrying out system development, the method used is SDLC (System development life cycle) with a waterfall approach.

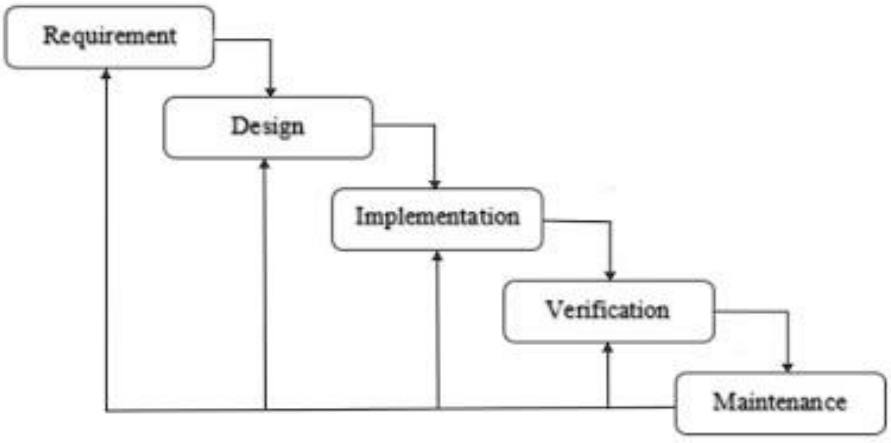

Figure 1. Waterfall Model

waterfall method has several successive stages, namely:

1. Requirements Analysis. At this stage, the system developer needs communication that aims to understand the software expected by the user and the limitations of the software. This information can usually be obtained through interviews, discussions or direct surveys. Information is analyzed to obtain the data required by the user.
2. System Design, Requirements specifications from the previous stage will be studied in this phase and a system design is prepared. System Design helps in specifying the hardware (hardware) and system requirements and also helps in defining the overall system architecture.
3. Implementation At this stage, the system is first developed in small programs called units, which are integrated in the next stage. Each unit developed and tested for functionality is referred to as unit testing.
4. Integration & Testing, All units developed in the implementation phase are integrated into the system after testing is carried out for each unit. After integration the entire system is tested to check for any failures or errors.
5. Operation & Maintenance, the final stage in the waterfall model. Finished software, run and perform maintenance. Maintenance includes fixing errors that were not found in the previous step. Repair implementation system units and system service improvements as new requirements [9].

3.6 Context Diagram

Context diagram is a diagram that includes basic inputs, general systems and outputs. a diagram that comprises a process and describes the scope of a system. Context diagram is also the highest level of DFD which describes all inputs into the system or output of the system which gives an overview of the whole system.

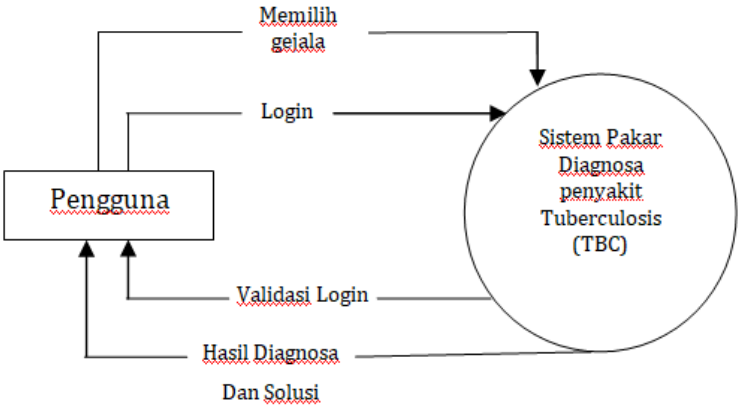

Figure 2. Context diagram

IV. DISCUSSION

4.1 Implementation

System design aims to make system design during research, test and document program procedures required by approved system design documents. This TB disease diagnosis expert system program uses Visual Basic. The following is a display of the expert system program that has been made [10].

a. Login Form display

The Login Form functions to process entry into the system. The login form display can be seen in Figure 3.

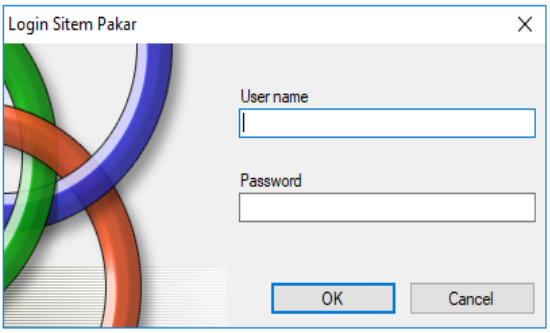

Figure 3. Login form

b. Expert system programs

The display of the main form of the expert system program is filled in by the user by selecting the symptoms they are experiencing. The user selects more than one symptom available in the program. Then the user selects the diagnostic button to view the diagnostic results.

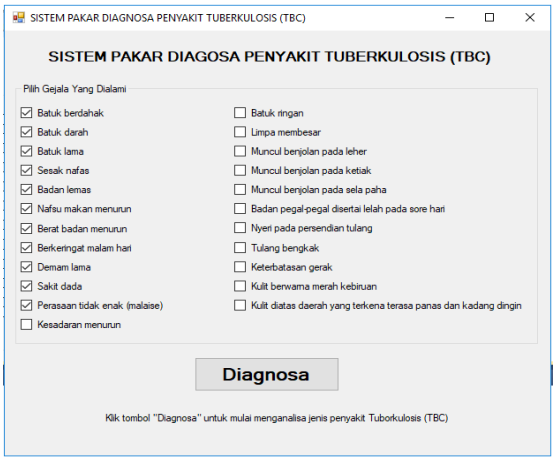

Figure 4. Display of the expert system program.

c. Display results and solutions

After the user performs a diagnosis, the results of the disease will appear as well as the solutions suggested by the system to the user. Display results and solutions can be seen in Figure 5.

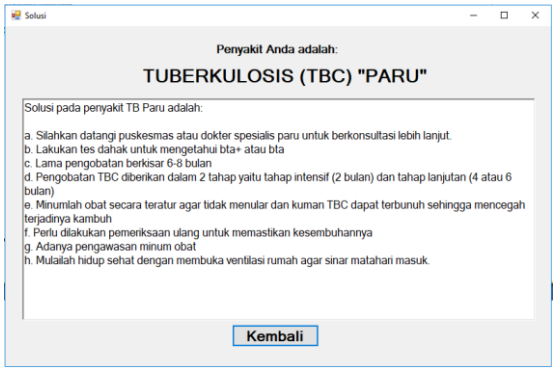

Figure 5. Display of results and solutions

V. CONCLUSION

5.1 Conclusion

Based on the results of the expert system design, for the diagnosis of TB disease using the visual basic-based forward chaining method, the following conclusions can be drawn:

1. Research has succeeded in developing an expert system for diagnosing TB disease using the visual basic based forward chaining method and it is running well.
2. The results of the output of the expert system for diagnosing TB disease produce results accompanied by solutions/suggestions for handling them.

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5.2. Suggestion

The author understands that this system is not perfect and there are still many shortcomings, for that the author gives the following suggestions:

1. The need for further development of an expert system for diagnosing tuberculosis based on visual basics with the development of information and network technology, for example by developing an Android-based expert system that is easier and more mobile to operate.

2. The user as a user of the system should be able to provide feedback for the future development of the system, so that the system will always be able to meet the needs of the user.

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