

Expert System for Identifying Pregnant Using Forward Chaining

Gilang Aditia¹, Afzal Ziqri², Aldhan Tri Maulana³, Faisal Dharma Adhinata^{*4}

^{1,2,3,4}*Faculty of Informatics, Institut Teknologi Telkom Purwokerto, Indonesia
Jl. DI Panjaitan No. 128, Karangreja, South Purwokerto, Banyumas, Central Java*

¹19104043@ittelkom-pwt.ac.id

²19104002@ittelkom-pwt.ac.id

³19104059@ittelkom-pwt.ac.id

^{*4}faisal@ittelkom-pwt.ac.id

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Abstract

Pregnancy is a biological process in which sperm and eggs meet each other to fertilize, and the fetus is formed in the uterus. But it's difficult; pregnant mothers sometimes have problems or discomfort during pregnancy. In addition, in areas far from the city, there are many obstacles to consulting an obstetrician. Therefore, it will be dangerous if mothers experience problems and find it difficult to get first aid. This research aims to create an expert system for pregnant women where it is not difficult for a mother to go to the doctor to ask about her complaints. The solution offered in this study is easy to access to the SP BUMIL website and automatically enters all mothers' complaints into the system. This system also provides a diagnosis and advice to pregnant women as to the best steps and an explanation of what the pregnant woman is suffering from. This expert system uses the forward chaining method, which has the advantage of producing a solution to a problem; in other words, being able to consider a problem and draw conclusions according to the facts. On this website, there is a disease information menu and also the results of the diagnosis.

Keywords: Diagnosis, Pregnancy, Expert systems, Forward chaining

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Corresponding Author:

*Faisal Dharma Adhinata
Faculty of Informatics, Institut Teknologi Telkom Purwokerto, Indonesia
Jl. DI Panjaitan No.128, Karangreja, Banyumas, Jawa Tengah
Email: faisal@ittelkom-pwt.ac.id

I. INTRODUCTION

The health of pregnant women and prospective babies or fetuses is very important. Many pregnant women experience a miscarriage or the death of the fetus in the womb. The case is relatively high; based on the Millennium Development Goals (MDGs), the maternal mortality rate in 2015 was 102 per 100,000 live births [1]. Problems in the womb are very important because they function as a place for the baby before birth. However, the lack of knowledge and information about diseases with various symptoms can cause delays for pregnant women in knowing the occurrence of diseases in their pregnancy, which can result in miscarriages. These changes make the bodies of pregnant women feel different and can cause various kinds of complaints. These complaints can cause concern for pregnant women and their partners. Pregnant women face problems due to the lack of medical personnel, such as midwives, and the availability of facilities and infrastructure [2]. According to the MMR, birth is a big challenge for Indonesia because maternal mortality is very high. Many factors influence early symptoms of disease, which are indicators of prevention so that treatment can be carried out properly [3].

Pregnant women must have their wombs checked to know the fetus's health in the womb. However, sometimes in certain areas, it is very difficult to find a doctor or midwife, or the schedule is so busy that it is difficult to have it checked, which makes it difficult for pregnant women to consult. It makes the risk of interference for pregnant women very high because they underestimate the symptoms that arise in the womb. Therefore, to reduce the number of miscarriages or failure of pregnant women to give birth, an expert system for diagnosing gynecological diseases based on forward chaining was created so that it can diagnose disorders in pregnancy. Treatment with this system can solve the form of a disease according to the symptoms experienced by pregnant women. The time needed to produce the solution is faster when compared to the manual method. This expert system can analyze visible (physical) and invisible (felt by the sufferer) symptoms to find a solution [4].

Technology is also very important in the medical field to help improve services. For people with busy doctor activities, expert systems are becoming the main goal for finding or looking for health information. However, especially in the womb, pregnant women have very limited movements. So that makes the expert system's main goal only to consult or dig up information [5].

An expert system is a program that can store the knowledge and rules of an expert. This expert system can support decision-making. This system can collect and store knowledge from several experts. This system uses a discussion system, like experts, to solve problems. Therefore, this expert system stores some knowledge [6], which can solve certain problems. Several previous studies have been conducted to build an expert system to identify diseases and conditions in pregnant women.

This expert system produces output in the form of possible pregnancy diseases based on the symptoms felt by the user. This expert system can be an expert or a means of storing knowledge about pregnancy disorders from an expert. This expert system can assist patients and doctors in providing decision support systems and expert advice, so this problem must be addressed immediately [7].

II. LITERATURE REVIEW

Expert systems are part of artificial intelligence (AI) and were discovered by the AI community in the mid-1960s. The basic idea behind expert systems is to make it easier for experts with specific knowledge to be transferred to computers. This knowledge is then stored on the computer and can be retrieved by the user when needed. Furthermore, like the consultations that occur in humans, computers can provide input and explanations [8]. It is also reinforced that an expert system is a computer program or software that knows an expert in dealing with a problem [9]. The system uses this knowledge to solve the problem, just like an expert.

Expert systems have been developed in various subjects such as agriculture, computer science, chemistry, medicine, geology, space technology, and others. Expert systems have various advantages over human expertise because expert systems are affordable, permanent, consistent, fast-processing, and can be duplicated. Meanwhile, human expertise is perishable, unpredictable, expensive, and slow in processing and development. However, expert system methodologies tend to be problem-oriented, and a new methodology is needed that utilizes social sciences such as psychology, cognitive science, and human behavior, which can be implemented by expert systems as another method of choice [10].

- 1) Knowledge Base System (KBS): A knowledge-based system is a system that uses a set of knowledge coded into machine language to be able to conclude and perform a task. Knowledge-based systems help humans solve problems based on the knowledge programmed into the system. For this reason, a knowledge-based system is used in solving problems related to AI (artificial intelligence) [11].
- 2) Forward Chaining Method: According to Giarratano and Riley [12], forward chaining is one of the expert system methods that finds or tracks solutions to problems. In other words, he considers the information and concludes according to the facts. This method is the opposite of the original reverse chaining method, which starts with a hypothesis and ends with statements that support the hypothesis. In the forward chaining method, the description is not too simplified because the forward chaining method does not explicitly know the subgoals before finding the output. Forward chaining is also considered bottom-up reasoning or considerations because this method looks at low-level evidence, from coverage to high-level conclusions based on information.

III. METHOD

Research design is the research or implementation phase of creating the system. As research develops, the design will become more focused and progressive.

A. Flow chart

The main workflow we use can be seen in Figure 1.

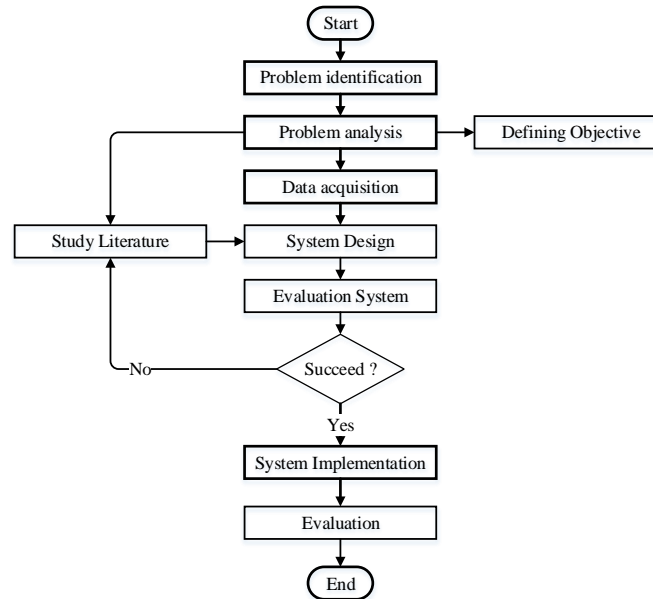


Figure 1. Flow Chart

Based on the picture above, the sequence is as follows:

- 1) **Problem identification:** Problem identification is how researchers divide problems or obstacles into groups and are used as subject decisions at the end of cases and studies.
- 2) **Problem Analysis:** This analysis was carried out using two methods, the comparative and the descriptive methods.
- 3) **Comparative Method:** An analysis that compares theory and practice to clarify differences and similarities.
- 4) **Descriptive Method:** Data compiled, collected, grouped, and analyzed to obtain an overview of the problems discussed.
- 5) **Defining Objectives:** From the description attached above, the achievements of the research are as follows: To receive news from users, especially pregnant women, the conditions for the fetus are very vulnerable to the health of pregnant women. For example, pregnant women usually experience pain that affects the fetus in the womb.
- 6) **Study Literature:** This aims to understand the knowledge or knowledge applied in this expert system. Search results are selected in the literature search process, and filtering search results are based on predetermined criteria [13].
- 7) **Collecting Data:** Data collection is carried out from various existing sources. Data was collected using three methods: literature survey, interviews, and observation.
- 8) **System Design:** The design phase begins with designing a database that accommodates all the statistics obtained through interviews with experts who understand and understand the symptoms of pregnant women.
- 9) **System Testing:** Testing the system against the concept of making this system aims to diagnose diseases in pregnant women. This expert system will provide information and education about the various diseases experienced by pregnant women. Therefore, users can utilize the built system optimally, and black box testing is carried out as a testing process.

- 10) System Implementation: At this stage, we re-evaluate whether the system designed for future use by users is feasible or whether the system still requires minor changes or improvements.
- 11) Evaluation: at this stage, there is a process of determining the value of an object or object according to specific references to determine certain goals.

B. Probability formulas

How to calculate the probability formula applied in this expert system was formulated by Prof. Ir. Rolly Intan, MASc., Dr. Eng. [14]. This formula calculates the probability of disease, as shown in Equation (1).

$$Probability = \frac{GU \cap P}{GP} \tag{1}$$

IV. RESULT AND DISCUSSION

A. Tools and materials

This study uses an HP laptop with Windows 11 operating system specifications, Intel Core i3 RAM 4GB with Render AMD Radeon Graphic Processor R7 M20 Materials Using Sublime text with CodeIgniter Framework and MySQL as the database.

B. Research result

The contents of the knowledge base, namely the rules and facts that are used based on the knowledge gained from the experience of several experts, research, and the experience of doctors working in this field, are very necessary regarding this expert system because they have experience in identifying symptoms of gynecological diseases and we as designers As for the expert system, data has been collected in table 1.

TABLE I
 CODE AND SYMPTOMS

Symptom Code	Physical Symptoms
G001	Light bleeding
G002	Pregnant (+)
G003	Shoulder pain
G004	Cramps in the lower abdomen usually accompany bleeding.
G005	Changes in the breast
G006	Breath feels heavier
G007	Pregnancy glow
G008	Frequent urination and constipation
G009	Sensitive sense of smell
G010	Cramps and spotting
G011	Morning sickness
G012	Headache
G013	vaginal discharge
G014	stomach cramps
G015	Exit blood spots (spots)
G016	Back pain
G017	Fetal movement
G018	Seizures Seizures
G019	Pain or burning when urinating
G020	Cloudy urine color
G021	Fever
G022	Abdominal pain
G023	Out of breath
G024	Constant feeling of wanting to urinate
G025	Mood swings
G026	Lazy to care for and clean up
G027	Cravings
G028	Nervous

Of the several diseases that will be entered, rules are designed according to what will happen in the book and consultation with experts (in this case, doctors). Compiled rules can be multi-level or non-level. Hierarchical law arises because several diseases have initial signs that are like or considered common symptoms. The rules for diseases that are not classified are diseases for which there are no other diseases in the database with similar general symptoms. This disparity arises because the types of diseases included are still very limited, with those that attack pregnant women the most [15]. Although, with the research results obtained, the system can present the diagnosis entered by the user by 60%, so from the following presentations, the user also needs to continue to consult directly with the doctor concerned so that the essence of the problem can be identified and also the doctor may be able to provide the necessary advice or suggestions carried out directly by the user, and the user can immediately ask questions and consult experts, this system is only the first indication of a problem that might occur.

C. Test result

The results of this study are in the form of a web-based system with the following appearance:

1) *Main page*: This primary page goes directly to the diagnostic page. On this page, the user can see a brief description of the program and its functions, namely an encyclopedia of diseases and an encyclopedia of symptoms, similar to Figure 2.

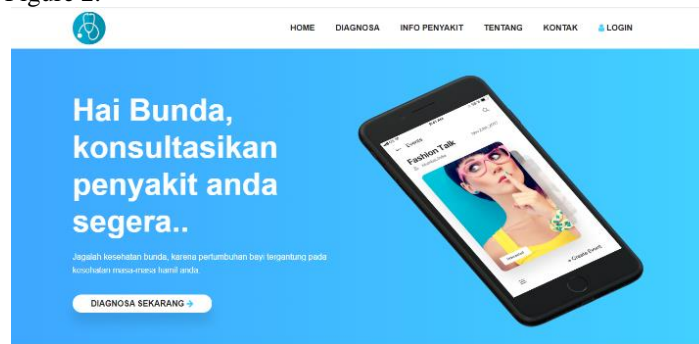


Figure 2. Main Page

2) *Diagnosis Page*: The Diagnostics page is for diagnosing the patient's disease. This page has live streaming where users provide information about the uterus condition based on the symptoms that exist in pregnant women. This page lists the different types of symptoms that pregnant women experience. The user only needs to display the symptoms that are felt in the uterus, as shown in Figure 3.

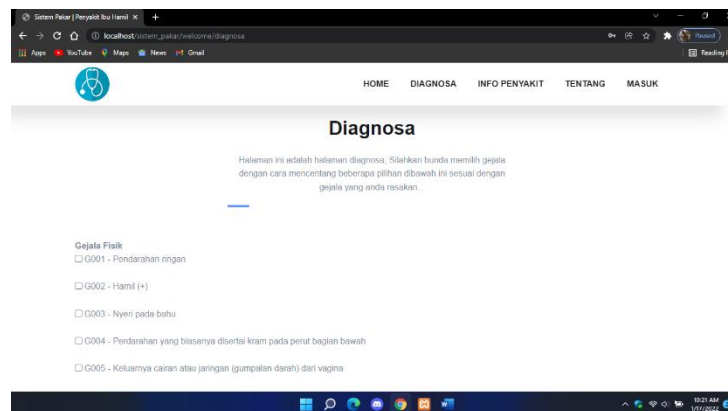


Figure 3. Diagnosis page

3) *Disease Info Page*: The Disease Info page provides additional literature to patients and added treatment and prevention methods that patients can read, as shown in Figure 4.

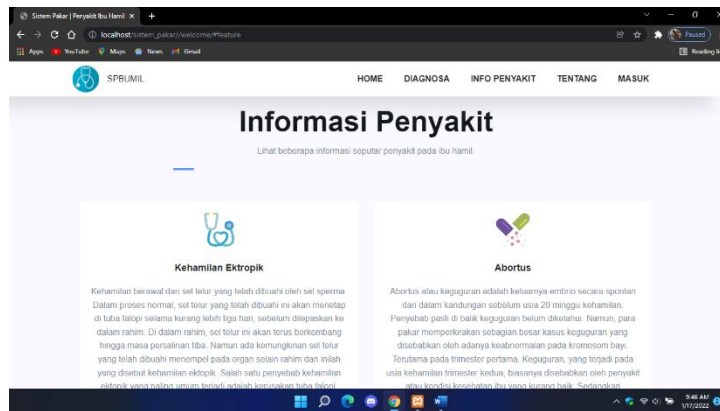


Figure 4. Disease Information Page

4) *About Page*: This page describes the pregnant woman expert system we have developed to facilitate information and diagnose diseases in pregnant women by simply accessing the SP BUMIL website, as shown in Figure 5.

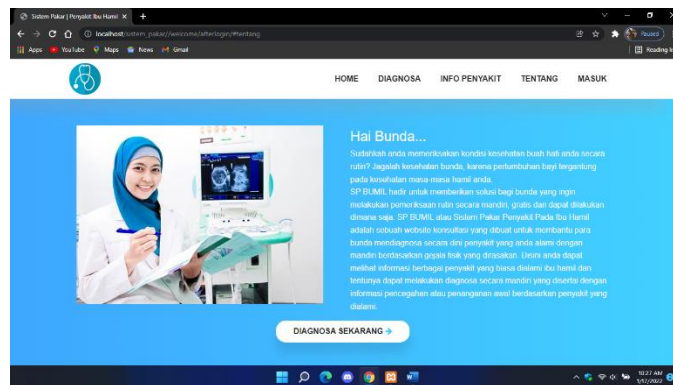


Figure 5. About page

5) *How the expert system works*: Users need to input all types of complaints in the DIAGNOSIS section. The system will process and calculate estimates of all types and values of complaints that the user inputs, like the example in Figure 6.

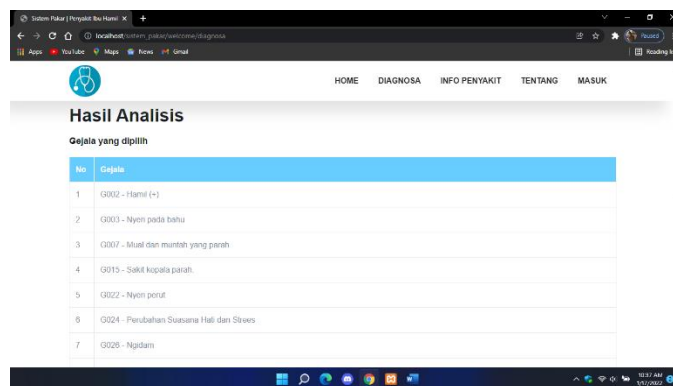
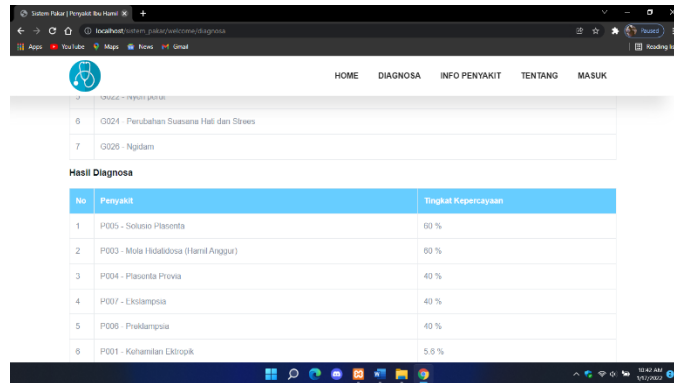


Figure 6. Analysis results (selected symptoms)

From the results of the analysis of the symptoms selected, the system will process and then calculate the diagnoses of the symptoms, as shown in Figure 7.

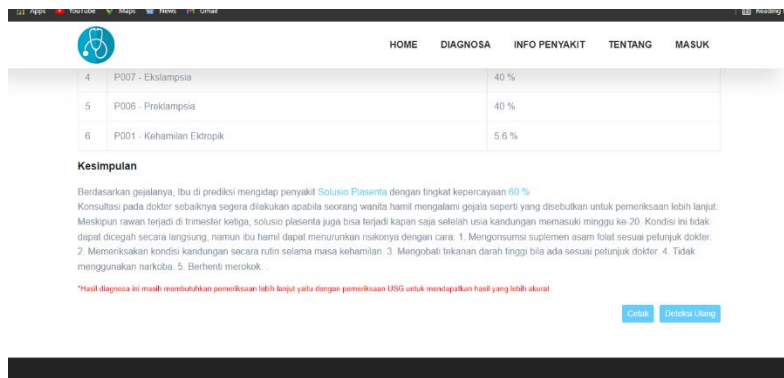


The screenshot shows a web application interface with a navigation menu (HOME, DIAGNOSA, INFO PENYAKIT, TENTANG, MASUK) and a list of symptoms (G024, G026). Below this is a table titled 'Hasil Diagnosa' with columns for 'No', 'Penyakit', and 'Tingkat Kepercayaan'.

No	Penyakit	Tingkat Kepercayaan
1	P005 - Solusio Plasenta	60 %
2	P003 - Mola Hidatidosa (Hamid Anggur)	60 %
3	P004 - Plasenta Provia	40 %
4	P007 - Eklampsia	40 %
5	P006 - Preklampsia	40 %
6	P001 - Kehamilan Ektopik	5,6 %

Figure 7. Diagnostic Results Page

And also, users can see the conclusions presented in the column under the results of the diagnosis, where there is information and advice for pregnant women, as shown in Figure 8



The screenshot shows the 'Kesimpulan' section of the application. It features a table with symptoms and their confidence levels, followed by a detailed text-based conclusion and advice for the user.

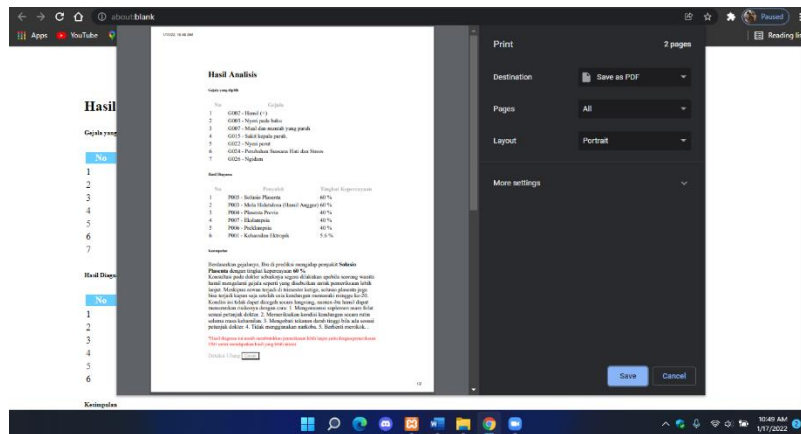
4	P007 - Eklampsia	40 %
5	P006 - Preklampsia	40 %
6	P001 - Kehamilan Ektopik	5,6 %

Kesimpulan
Berdasarkan gejalanya, Ibu di prediksi mengidap penyakit **Solusio Plasenta** dengan tingkat kepercayaan **60 %**. Konsultasi pada dokter sebaiknya segera dilakukan apabila seorang wanita hamil mengalami gejala seperti yang disebutkan untuk pemeriksaan lebih lanjut. Meskipun rawan terjadi di trimester ketiga, solusio plasenta juga bisa terjadi kapan saja setelah usia kandungan memasuki minggu ke-20. Kondisi ini tidak dapat dicegah secara langsung, namun ibu hamil dapat menurunkan risikonya dengan cara: 1. Mengonsumsi suplemen asam folat sesuai petunjuk dokter. 2. Memeriksa kondisi kandungan secara rutin selama masa kehamilan. 3. Mengobati tekanan darah tinggi bila ada sesuai petunjuk dokter. 4. Tidak menggunakan narkoba. 5. Berhenti merokok.

**Hasil diagnosa ini masih membutuhkan pemeriksaan lebih lanjut yaitu dengan pemeriksaan USG untuk mendapatkan hasil yang lebih akurat.*

Figure 8. Conclusion page

And also, the user can print the diagnosis results, as shown in Figure 9.



The screenshot shows a print dialog box overlaid on the diagnostic results page. The dialog box includes options for 'Destination' (Save as PDF), 'Pages' (All), and 'Layout' (Portrait). The background page shows the 'Hasil Analisis' section with a table of symptoms and a conclusion.

Figure 9. Print Page

V. CONCLUSION

Users can immediately get a diagnosis of the complaints they are suffering by simply entering data online on this website without seeing a doctor, and they can also get advice or referrals. However, when you are pregnant, with the percentage of results from a 60% belief system contained in the conclusion of the program, it is necessary to continue to see a doctor for further information so that the diagnosis is more specific and you can also ask questions directly to the doctor.

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