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Web-Based Expert System for Diagnosing Disease Symptoms Caused by Prolonged Exposure to Laptop Screens Using the Certainty Factor Method

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Abstract: Programmers are often faced with the pressure of completing projects within tight deadlines, whether during system development or when fixing bugs. This situation frequently leads them to work for extended periods in front of computer screens, often neglecting health considerations. Such habits can trigger various physical and mental health issues, including eye strain, muscle pain, sleep disturbances, and excessive stress. Based on these conditions, this study aims to design a web-based expert system that can detect early signs of potential health problems resulting from intensive digital device usage. The system was developed using the Laravel framework, which adopts the Model-View-Controller (MVC) architecture and supports application security. For the inference process, the Certainty Factor method was applied to calculate the confidence level of a diagnosis based on user-input symptoms. Knowledge about symptoms and diseases was obtained through consultations with experts and formulated into rules used by the system. In one of the tests, a user named Agus was diagnosed with Computer Vision Syndrome with a confidence level of 99.93%. This result demonstrates that the method effectively manages uncertainty and produces accurate decisions. In addition to providing diagnoses, the system also offers initial recommendations such as applying the 20-20-20 rule and adjusting screen positioning. Therefore, this system is considered effective as a preliminary consultation tool to help programmers recognize health issues before seeking professional medical assistance.

Keyword: Expert System, Certainty Factor, Laravel, Programmer Health, Symptom Diagnosis, Early Detection

INTRODUCTION

The advancement of information technology has driven a transformation in work patterns, particularly in the field of software development, which heavily relies on computer usage. One profession closely associated with digital activities is programming, where practitioners often spend hours in front of screens. Such prolonged and repetitive working durations can impact health conditions, ranging from physical issues like muscle tension and eye fatigue to psychological problems such as stress and reduced concentration.

Unfortunately, the early symptoms of these conditions are often unnoticed or ignored due to intense work focus and limited awareness of occupational health. If left unaddressed, these conditions may develop into serious health problems. Therefore, a system is needed to help identify symptoms early and provide initial information and recommendations before consulting medical professionals.

One applicable solution is the use of an expert system—an artificial intelligence system designed to replicate the reasoning of a human expert in solving specific problems. This system utilizes a knowledge base and expert-defined rules to provide diagnostic decisions. In this study, the expert system is employed to recognize common health-related symptoms experienced by programmers. It also serves an educational purpose by providing users with insight into their health conditions independently.

The purpose of this research is to design and develop a web-based expert system using the Certainty Factor method to analyze symptoms entered by users. The use of the Laravel framework in system development is expected to facilitate accessibility while ensuring data security.

METHOD

Information regarding several types of diseases, along with their descriptions and treatment steps, is presented in Table 1 below.

Table 1. Programmer Disease Data

Disease Code	Disease Name	Description	Treatment
P01	Computer Vision Syndrome / Digital Eye Strain	A condition caused by prolonged screen time on computers, phones, or tablets without breaks. Leads to eye strain, visual disturbances, and headaches.	A. Apply the 20-20-20 rule (every 20 minutes, look at something 20 feet away for 20 seconds). B.Use eye drops to keep eyes moist melembapkan mata. C.Adjust the screen to eye level and reduce brightness D.Take regular breaks from screen use
P02	Musculoskeletal Disorder (MSD)	MSD refers to disorders of the muscles, nerves, and joints due to poor posture while working on a computer. Common symptoms include neck, shoulder, back pain, and hand/wrist pain (Carpal Tunnel Syndrome).	A. Improve sitting posture and screen position. Stretch every hour. B. Use back support and ergonomic desk setup. C. Apply warm compresses or take pain relievers if necessary.
P03	Burnout Syndrome	Caused by prolonged unmanaged work stress, characterized by mental fatigue, sleep disturbances, poor concentration, irritability, and anxiety.	A. Manage work-rest schedule B. Ensure sufficient and quality sleep. C. Do relaxation activities such as meditation, yoga, or light exercise. D. Consult a psychologist or counselor if stress persists.
P04	Neck and Back Pain (Tech Neck)	Poor posture while looking at screens leads to muscle pain, stiffness, and soreness in the neck, shoulders, and back.	A. Correct sitting posture, adjust desk and screen height. B. Regularly stretch neck, shoulder, and back muscles. C. Use ergonomic chair with proper back support. D. Avoid sitting too long without standing or moving.

P05	Obesity and Metabolic Disorders	Lack of physical activity due to prolonged sitting can lead to weight gain and metabolic problems such as diabetes and high cholesterol.	A. Maintain a healthy, balanced diet. B. Exercise and stay active even when working at a desk. C. Drink enough water, avoid high-calorie snacks. D. Regularly check blood sugar and cholesterol levels.
P06	Insomnia	A sleep disorder marked by difficulty falling asleep or poor sleep quality. Often caused by work stress, excessive gadget use, or unhealthy lifestyle habits.	A. Keep a consistent daily sleep schedule. B. Avoid gadget use before bedtime. C. Reduce caffeine and alcohol consumption. D. Create a comfortable and cool sleeping environment.

Table 2 below presents symptom data associated with each disease. This information was obtained through interviews and direct data collection from experts with expertise in occupational health.

Table 2 Symptom Data Based on Expert Input Each symptom is identified with a unique code and a brief description, which serves as the basis for the diagnostic process.

No	Symptom Code	Symptom Name
1	G01	Tired eyes , stings, or dry eyes
2	G02	Headache or migraine
3	G03	Blurred vision after prolonged screen time
4	G04	Nausea or dizziness after staring at the screen
5	G05	Ringing in the ears
6	G06	Red and dry eyes
7	G07	Eyes feel tired and sore
8	G08	Neck and shoulder pain
9	G09	Wrist or finger pain
10	G10	Lower back pain
11	G11	Stiffness or soreness in the neck, shoulders , and back
12	G12	Pain in hands and wrists (carpal tunnel)
13	G13	Difficulty sleeping or poor sleep quality
14	G14	Easily irritated or stressed
15	G15	Difficulty concentrating
16	G16	Frequently feeling tired despite little activity
17	G17	Ringing in the ears
18	G18	Anxiety or mental fatigue
19	G19	Severe burnout symptoms
20	G20	Muscle stiffness or soreness
21	G21	Muscle pain in the neck, shoulders, and back
22	G22	High blood sugar/cholesterol levels
23	G23	Weight gain
24	G24	Poor sleep quality
25	G25	Trouble falling asleep

Table 3 below presents the production rules used to identify health symptoms in programmers.

Table 3. Expert System Rules

No	Diagnostic (Rule)	Disease Conclusion
1	If Symptoms G01, G02, G03, G04, G05, G06, and G07 are present	Then indicates P01
2	If Symptoms G08, G09, G10, G11, and G12 occur together	Then indicates P02
3	If Symptoms from G13 to G19 are found	Then indicates P03
4	If symptoms G20 and G21 are detected	Then indicates P04
5	If symptoms G22 and G23 are present	Then indicates P05
6	If symptoms G24 and G25 appear	Then indicates P06

A decision determines the diagnostic process. The system will review and analyze the type of disease based on the available symptoms to provide a moreaccurate result. Figure 1 below shows the Decision Tree diagram.

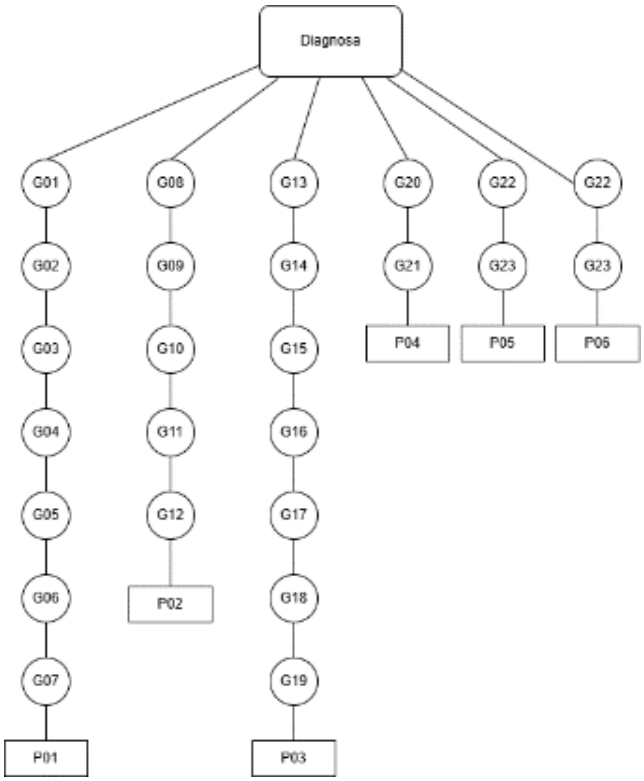

Figure 1. Decision Tree

The disease diagnosis process in the system is carried out by tracing the facts or symptoms entered by the user and then matching them with predefined rules using the Certainty Factor method. This diagnostic flow is illustrated in Figure 2 below.

A system flowchart is a sequence of steps that illustrates how a system or program operates, as shown in Figure 3 below.

The Entity Relationship Diagram (ERD) is a graphical representation of the data structure modeled within a database to illustrate the relationships between entities, attributes, and relations in the system. Figure 4 below shows the ERD design to be developed.

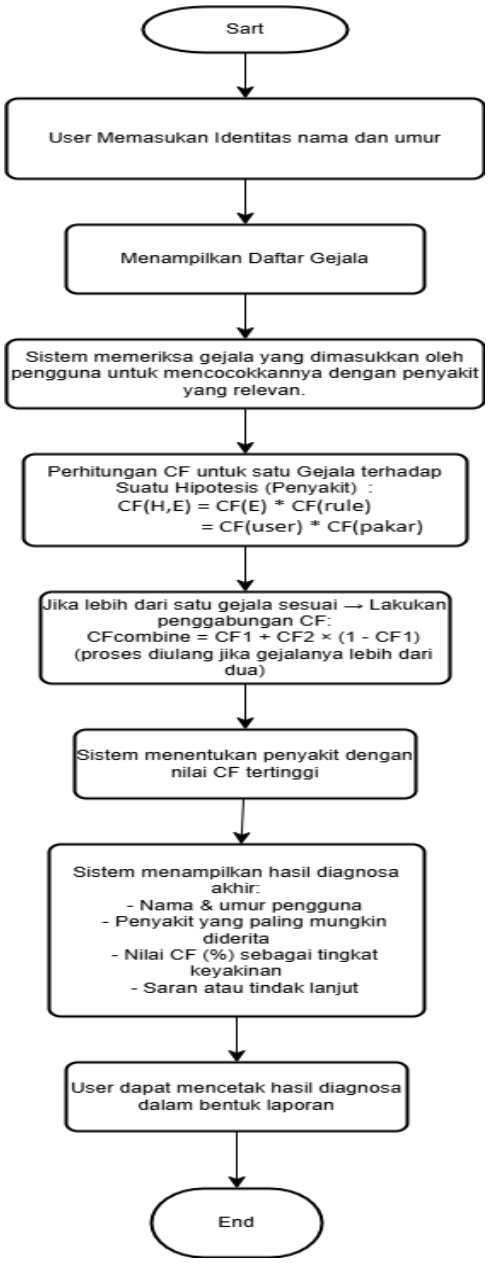

Figure 2. System Diagnosis Algorithm

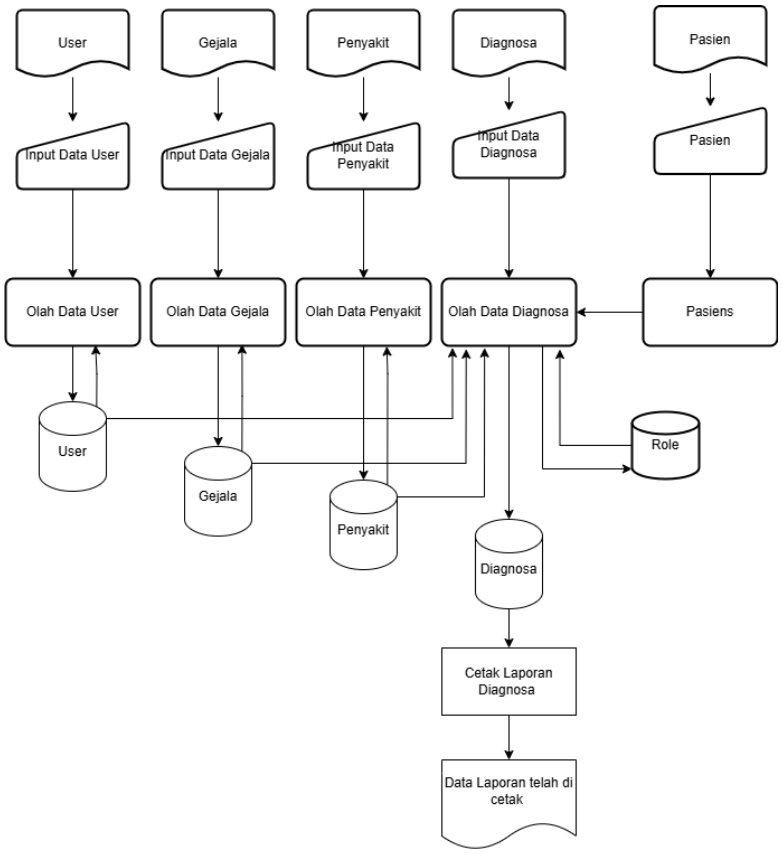

Figure 3. System Flowchart

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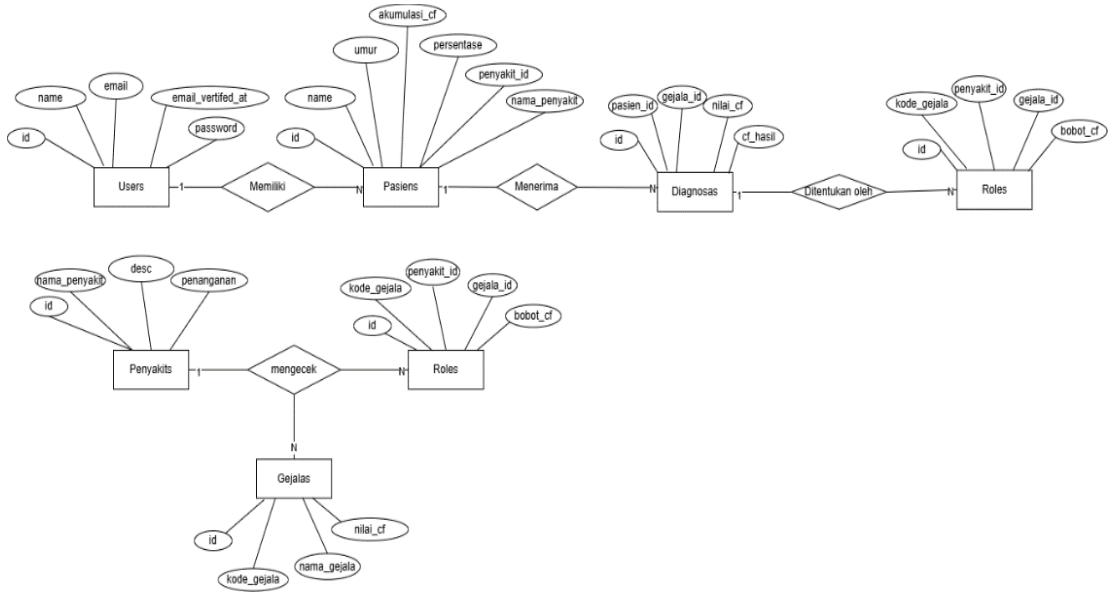

Figure 4. Entity Relationship Diagram (ERD)

RESULTS AND DISCUSSION

The expert system application interface on the Diagnosis menu for one of the patient data, a programmer named Agus, along with the calculation results, is shown in Figure 5 below.

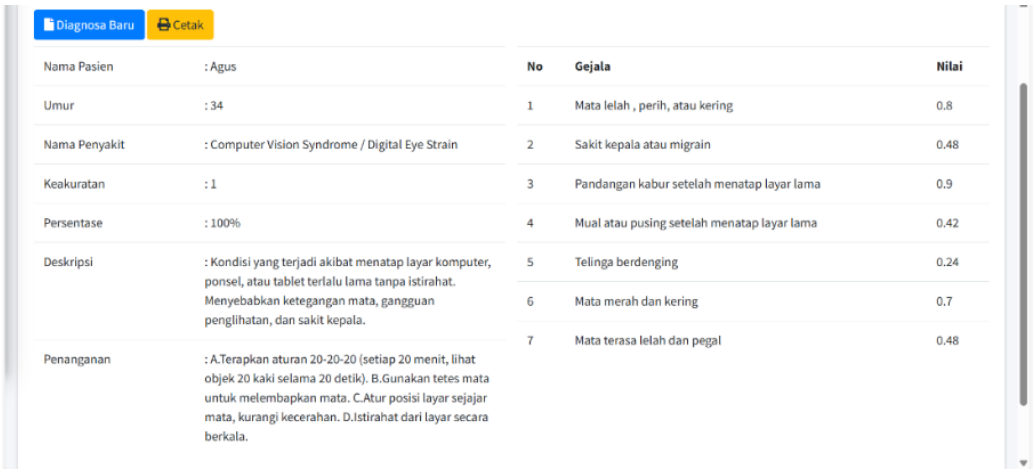

Figure 5. Disease Diagnosis Result

After the patient inputs the symptoms, the system processes the data using the Certainty Factor (CF) method to determine the level of confidence in a diagnosis. The symptom of tired, sore, or dry eyes. has the highest CF value of 0.8 (almost certain), followed by headache or migraine with a value of 0.48."

Based on the combination of CF values and the available rule base, the system generates a diagnosis of Computer Vision Syndrome / Digital Eye Strain with an accuracy level of 100 or 100%. The system also recommends treatments such as the 20-20-20 rule, the use of eye drops, screen position adjustment, and regular breaks. The following is the Certainty Factor (CF) table selected by the user based on their level of confidence in each symptom experienced. These CF values are converted from linguistic terms such as 'Most Likely', 'Almost Certain', and 'Certain' to be used in the expert system's calculation process.

Table 6. Determination of User Certainty Factor

CF User	CF Weight
Most Likely	0.6
Possibly	0.8
Certain	1

The table above shows the Certainty Factor (CF) values provided by the user based on their level of confidence in an observed fact or symptom. The user's level of belief in a symptom is represented by the CF value, which is used in the inference mechanism of the expert system. There are three CF value categories in the table.

a) Most Likely (CF = 0.6): Indicates that the user has a relatively high level of confidence in a condition, although there is still some degree of uncertainty.
b) Almost Certain (CF = 0.8): Suggests that the user is nearly sure about the observed condition, with very little uncertainty.
c) Certain (CF = 1.0): Represents full confidence from the user without any doubt regarding the condition being assessed.

Table 7. Expert CF Values and Certainty Term

No	Symptom Code	Symptom Name	User CF	Expert CF	User CF * Expert CF
1	G01	Tired, sore, or dry eyes	Certain	0.8	0.8
2	G02	Headache or migraine	Almost Certain	0.6	0.48
3	G03	Blurred vision after prolonged screen time	Certain	0.9	0.9
4	G04	Nausea or dizziness after prolonged screen time	Most Likely	0.7	0.42
5	G05	Ringing in the ears	Most Likely	0.4	0.24
6	G06	Red and dry eyes	Certain	0.7	0.7
7	G07	Eyes feel tired and sore	Almost Certain	0.6	0.48

This table is used in the inference calculation process of the expert system. The CF Rule value represents the expert's degree of confidence in the relationship between a symptom and the diagnosed disease. The Certainty Term is used to simplify the numerical representation into linguistic terms that are easier for lay users to understand.
The CF value is calculated using the following equation:

CF(H,E) = CF(E) * CF(rule) = CF(User) * CF(Expert)

The equation calculates the confidence value in a hypothesis (disease diagnosis) based on the combination of confidence levels from both the user and the expert for a specific symptom. The result of this calculation serves as the basis for determining the combined CF value for each symptom. The following is a sample manual calculation by the system to determine the confidence percentage based on the symptom inputs shown in Figure 5.
The first step is to multiply the User CF × Expert CF for each symptom. Once the CF value for each symptom is obtained, the system gradually combines them using the following formula:
$CFcombine=CF1+CF2\times(1-CF1)$
Based on the symptom data from the patient named Agus, the following is the result of the manual calculation:
CF1 = 0.8
CF2 = 0.48
CFcombine = 0.8 + 0.48 × (1 − 0.8) = 0.896
CFcombine = 0.896 + 0.9 × (1 − 0.896) = 0.9896
CFcombine = 0.9896 + 0.42 × (1 − 0.9896) = 0.99397
CFcombine = 0.99397 + 0.24 × (1 − 0.99397) = 0.99542
CFcombine = 0.99542 + 0.7 × (1 − 0.99542) = 0.99863
CFcombine = 0.99863 + 0.48 × (1 − 0.99863) = 0.99929
Thus, based on the final calculation result above, the combined CF value (CFcombine) obtained is 0.99929 or equivalent to 99.93%. This value indicates a very high level of system confidence in the diagnosis of Computer Vision Syndrome / Digital Eye Strain. In practice, this value is often rounded to 100% in the system interface to facilitate user understanding.

This high value is obtained because almost all of the main symptoms required by the system rule (Rule 1) were identified by the user, and the confidence levels provided were also high (ranging from "Almost Certain" to "Certain"). This demonstrates that the Certainty Factor method can produce precise diagnostic results even in the presence of uncertainty in the user's input data.

Additionally, this approach also enables the system to provide early treatment recommendations that are appropriate for the detected condition, helping to prevent potential health issues from becoming more severe in the future.

CONCLUSION

Based on the results of research and testing of the expert system developed to diagnose health issues experienced by programmers due to prolonged screen exposure, it can be concluded that:

1. The web-based expert system built using the Certainty Factor method and the Laravel framework is capable of performing diagnostic processes effectively based on the symptoms inputted by the user.
2. The calculation result of the combined CF value (CFcombine) shows a system confidence level of 99.93% in the diagnosis of Computer Vision Syndrome / Digital Eye Strain. This indicates that the Certainty Factor method can accommodate uncertainty in user data and produce precise diagnostic outputs.
3. The system provides informative diagnostic results that are easy to understand for general users, along with relevant early treatment suggestions. This makes the system an effective tool for early detection of health issues caused by computer-based work.
4. The high level of accuracy in the calculations is achieved through the fulfillment of key symptoms and the high level of user confidence in the symptoms they experience. Therefore, this system can help prevent more serious health impacts if used regularly.
5. Overall, this system can serve as an efficient initial consultation medium, especially for programmers or digital workers, to recognize and address health symptoms as early as possible without the immediate need to consult medical professionals.

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