Expert System Diagnosis Human Eye Diseases Using Certainty Factor Method Web-Based

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Abstract— Eye is the important senses. If the eye is disrupted then ignore it, it will disturb. In fact, many people delay to checked eye diseases that them suffered, due to the lack of knowledge society, the cost is quite expensive and the imbalance between patients and doctors so that should be queued if will check the eye health. It is necessary for the expert system that can diagnose eye diseases, so a people can checking their eye diseases suffered without have to go to the doctors. This expert system is based on web with the programming language PHP and MySQL database. In the process of withdrawal conclusion, system using the certainty factors method that use a value to assume degree of confidence from an expert to a data. Expert system provides results in the form of the possibility of illness suffered, the value of the percentage of beliefs from the illness and the treatment solution based on the value of confidence that given and system is able to know the type of eye disease experienced by the user based on the symptoms chosen by the user. So, it can help the people to know the eye disease their suffered and the action can be done faster.

Keywords—Expert System, Eyes, Eye Desease, Certainty Factor, Web

INTRODUCTION

The development of information technology today has undergone many changes, all areas of world life are colored by the application of technology. One of the obvious forms of technology is the implementation of computerized systems, with that system being able to complete a job quickly, effectively and efficiently, so as to minimize the mistakes that occur.

Technology has been used in various fields, one of which is in the field of health. Health is important thing for human beings including eye health, because with the eyes, humans can interact with the surrounding environment. If the eye is impaired and ignores it, it may be an early symptom of an eye disease that can interfere with the sufferer's activity. But in fact many people consider trivial and delayed to have the eye disease checked. This can be due to the absence of time or limitation of the place to do inspections, expensive costs, lack of public knowledge in the field of health, and the imbalance between patients and doctors so that it must be queued first if you want to check eye health. Remote areas are also one cause of the slow handling of eye diseases, caused by the limited or absence of an expert doctor in the area.

Health knowledge is important for everyone to prevent and maintain their health. Fast and precise information of an eye health expert is needed. Therefore, the author tries to create an application for an expert system to know the results of the diagnosis based on the symptoms of the eye diseases in an application of the system of experts who are expected to be able to provide early diagnostic information of eye diseases suffered.

LITERATURE REVIEW

An expert system is a system designed to be able to simulate an expert's expertise in answering questions and solving a problem. The expert system will provide solving a problem from the dialogue with the user. With the help of an expert system of people who are not experts/experts can answer questions, solve problems, and make decisions that are usually done by experts (Sutojo, 2011).

The knowledge of an expert system may be represented in several ways. One of the most common methods to represent knowledge is that in the case of a rule type (rule) IF... Then. Although the way above is very simple, but many things mean in building an expert system by expressing expert knowledge in the form of the above rules (Hayadi, 2017).

The certainty factor expresses confidence in an event (or fact or hypothesis) based on evidence or expert judgment. Certainty factor uses a value to assume the degree of an expert's belief in a data. There are two ways of gaining a confidence level (CF) of a rule, namely:

1. The ' Net Belief ' method proposed by E.H. Shortliffe and B.G. Buchanan

    $$CF (Rule) = MB (H, E) – MD (H, E)$$

2. By interviewing an expert

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The value of CF (Rule) is obtained by the interachievement of the "term" from the expert, which is converted into a specific CF value according to the following table.

Table 1
The value of CF (Rule)

Uncertain Term	CF
Definitely not	-1.0
Almost certainly not	-0.8
Probably not	-0.6
Maybe not	-0.4
Unknown	-0.2 to 0.2
Maybe	0.4
Probably	0.6
Almost certainly	0.8
Definitely	1.0

The following is a description of several combinations of certainty factors on various conditions:
1. Certainty factor for rule with single premise rules:
   CF (H, E) = CF (E) * CF (rule) = CF (user) * CF (Expert)
2. Certainty factor for rules with multiple premise rules:
   CF (A AND B) = Minimum (CF (a), CF (B)) * CF (rule)
   CF (A OR B) = Maximum (CF (a), CF (B)) * CF (rule)
3. Certainty factor for rules with similarly concluded rules:
   CF combine (CF1, CF2) = CF1 + CF 2 * (1-CF1)

METHOD

The certainty factor (CF) value is determined for each symptom that corresponds to a specific disease in a range of values of 0 to 1. This value represents an expert's belief in a symptom affecting the occurrence of a particular eye disease.

Table 2
Diseases Data

Disease Code	Disease Name
P01	Ablasi Retina
P02	Conjungtivitis
P03	Bintit
P04	Blefaritis
P05	Dakriosistitis
P06	Dermatochalasis
P07	Endoftalmitis
P08	Entropion
P09	Floater
P10	Glaukoma
P11	Iritis
P12	Cataract
P13	Keratitis
P14	Minus
P15	Plus

Table 3
Symptoms Data

Symptom Code	Symptom	Symptom Code	Symptom
G01	Blurred vision	G26	When the tear bag is pressed, it will come out like pus
G02	Experience floater	G27	Difficulty keeping eyes open
G03	Fotopsia (Light flashes sensation)	G28	Upper eyelashes cover the View

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Code	Symptom	Code	Symptom
G04	Eye flushed	G29	Eyes become strained and pain due to raising eyelids
G05	Out Dirt	G30	Looks tired and sleepy
G06	Get something in one's eye	G31	Headaches
G07	Difficulty opening the eyelids when waking up early or prolonged closing your eyes	G32	Swollen eyes
G08	Painful eyes	G33	Eyelid crust
G09	Eyes feel hot	G34	Nerve disorders of the eye
G10	Watery eyes	G35	Small pupils
G11	Itchy eyes	G36	Difficult to see close quarters
G12	Small swollen redness of the eyelids and pain	G37	Double engagement in one eye (When the other eye is closed)
G13	The eyelid is noticeably sore and painful	G38	Swelling of the lens
G14	Fotofobia (Sensitivity to light)	G39	Experiencing a whiter color change on the black part of the eye
G15	Sore eyes	G40	There are white lesions of the cornea
G16	Eyelash loss	G41	Eye feeling tense
G17	Crusty eyelashes during waking up	G42	Eyes often moan
G18	Red Eyelid	G43	Quick Sleepy
G19	Skin exfoliation around the eyes	G44	Blurred vision when viewing distant objects
G20	Presence of thin membranes in the eyes	G45	Stiff on eyeballs
G21	Itchy Eye Angle	G46	Blurred vision when looking at nearby objects
G22	Swelling in the tear bags	G47	Vision is uncomfortable when the view is focused to a certain distance at a long time
G23	Pain in tear bags		
G24	Fever		
G25	Tired		

Table 4
Decisions Table

Disease Code	Symptoms Code
P01	G01, G02, G03
P02	G04, G05, G06, G07, G08, G09, G10, G11
P03	G10, G12, G13, G14
P04	G04, G05, G06, G10, G11, G12, G15, G16, G19
P05	G01, G04, G05, G06, G10, G21, G22, G23, G24, G25, G26
P06	G27, G28, G29, G30
P07	G01, G04, G08, G14, G24, G31, G32
P08	G01, G05, G06, G10, G14, G33
P09	G02, G03
P10	G01, G31, G34
P11	G04, G08, G14, G35, G36
P12	G01, G08, G10, G11, G14, G37, G38, G39
P13	G01, G04, G06, G08, G40
P14	G31, G41, G42, G43, G44, G45
P15	G31, G46, G47, G48

*name of corresponding author

The certainty factor (CF) value is determined for each symptom that corresponds to a specific disease in a range of values of 0 to 1. This value represents an expert's belief in a symptom affecting the occurrence of a particular eye disease.

Table 5
CF Value to Symptoms

No	Disease Name	Symptoms Code	CF Value	No	Disease Name	Symptoms Code	CF Value
1	Ablasi Retina	G01	0,6			G32	0,8
		G02	0,8			G31	0,4
		G03	0,4	8	Entropion	G01	0,2
2	Conjungtivitis	G04	0,4			G05	0,4
		G05	0,6			G06	0,8
		G06	0,8			G10	0,8
		G07	0,9			G14	0,4
		G08	0,4			G33	0,4
		G09	0,4	9	Floater	G02	0,8
		G10	0,8			G03	0,4
		G11	0,8	10	Glaukoma	G01	0,8
3	Bintit	G10	0,4			G31	0,4
		G12	0,8			G34	0,6
		G13	0,8	11	Iritis	G04	0,9
		G14	0,2			G08	0,8
4	Blefaritis	G04	0,6			G14	0,4
		G06	0,4			G35	0,6
		G10	0,4			G36	0,6
		G11	0,8	12	Cataract	G01	0.9
		G12	0,4			G08	0,8
		G15	0,4			G10	0,8
		G16	0,6			G11	0,2
		G19	0,2			G14	0,4
5	Dakriosistitis	G04	0,4			G37	0,8
		G05	0,4			G38	0,2
		G06	0,2			G39	0,8
		G10	0,4	13	Keratitis	G01	0,8
		G01	0,6			G04	0,6
		G21	0,4			G06	0,4
		G22	0,8			G08	0,6
		G23	0,8			G40	0,9
		G24	0,4	14	Minus	G31	0,4
		G26	0,8			G41	0,2
6	Dermatochalasis	G27	0,8			G42	0,8
		G28	0,6			G43	0,2
		G29	0,8			G44	0,9
		G30	0,8			G45	0,8
7	Endoftalmitis	G01	0,4	15	Plus	G31	0,2
		G04	0,9			G46	0,9
		G08	0,8			G47	0,6
		G24	0,4			G48	0,6
		G14	0,6				

The certainty factor algorithm requires the value of CF (confidence value) of the user to conduct a diagnosis. The CF value given by the user will be combined with the value of CF experts.

RESULT

A patient experiences an unknown type of eye disease. The symptoms experienced are:
- Watery eyes (G10). User Trust value: sure (0.8)
- Blurred vision (G01). User Trust value: a little unsure (0.4)
- Out Dirt (G05). User Trust value: sure (0.8)

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- Swollen eyes (G32). User Trust value: a little unsure (0.4)
- Suffer from Photophobia (G14). User Trust value: pretty sure (0.6)\
- Get something in one's eye. User Trust value: pretty sure (0.6)

Based on the user's answer, the process of diagnoses eye disease using certainty factor algorithm is as follows:

1. Calculation for retinal ablation disease

   $CF = CFexpert * CFuser = 0.6 * 0.4 = 0.24$ Confidence percentage $= 0.24 * 100\% = 24\%$

2. Calculation for Conjunctivitis disease

   $CF1 = CFexpert * CFuser = 0,8 * 0,8 = 0,64$

   $CF2 = CFexpert * CFuser = 0,6 * 0,8 = 0,48$

   $CFcombine (CF1,CF2) = CF1 + CF2 (1-CF1) = 0,64 + 0,48 (1-0,64)$

   $CFA = 0,8128$

   $CF3 = CFexpert * CFuser = 0,8 * 0,6 = 0,48$

   $CFcombine (CF3,CFA) = CF3 + CFA (1-CF3) = 0,48 + 0,8128 (1-0,48)$

   $= 0,902656$

   Confidence percentage $= 0,902656 * 100\% = 90,2656\%$

3. Calculation for Blefaritis disease

   $CF1 = CFexpert * Cfuser = 0,4 * 0,8 = 0,32$

   $CF2 = CFexpert * Cfuser = 0,6 * 0,8 = 0,48$

   $CFcombine (CF1,CF2)　　 = CF1 + CF2 (1-CF1) = 0,32 + 0,48 (1-0,32)$

   $CFA　　 = 0,6464$

   $CF3 = CFexpert * Cfuser = 0,4 * 0,6 = 0,24$

   $CFcombine (CF3,CFA)　 = CF3 + CFold (1-CF3) = 0,24 + 0,6464 (1-0,24)$

   $= 0,731264$

   Confidence percentage $= 0,731264 * 100\% = 73,1264\%$

4. Calculation for *Entropion* disease

   $CF1 = CFexpert * Cfuser = 0,8 * 0,8 = 0,64$

   $CF2 = CFexpert * Cfuser = 0,2 * 0,4 = 0,08$

   $CFcombine (CF1,CF2)　　 = CF1 + CF2 (1-CF1) = 0,64 + 0,08 (1-0,64)$

   $CFA = 0,6688$

   $CF3 = CFexpert * Cfuser = 0,4 * 0,8 = 0,32$

$CFcombine (CF3,CFA)　　 = CF3 + CFold (1-CF3) = 0,32 + 0,6688 (1-0,32)$

$CFB = 0,774784$

$CF4 = CFexpert * CFuser = 0,4 * 0,6 = 0,24$

$CFcombine (CF4,CFB) = CF4 + CFB (1-CF4)$

$= 0,24 + 0,774784 (1-0,24)$

$CFC = 0,82883584$

$CF5 = CFexpert * CFuser = 0,8 * 0,6 = 0,48$

$CFcombine (CF5,CFC)　　 = CF5 + CFC (1-CF5) = 0,48 + 0,82883584 (1-0,48)$

$= 0,9109946368$

Confidence percentage $= 0,9109946368 * 100\%$

$= 91,09946368\%$

From the CF calculations of each disease, the user is likely to be exposed to entropion with weights of 0,9109946368 or 91,09946368%.

Fig. 1 User diagnostic results

*name of corresponding author

CONCLUSION

This expert system is able to analyse the types of diseases experienced by users based on the symptoms chosen by the user. The application of certainty factor methods in this expert system can provide a level of confidence in the disease suffered by the user. This expert system can be used as a consideration material to help users in diagnosing eye diseases so that the treatment can be done faster.

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