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An Expert System To Diagnose Herpes Zoster Disease Using Bayes Theorem

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Abstract— *Computers are often used as a tool that can give conclusions to a disease so that it can help the community or health practitioners. Expert system is a field of science that can process the knowledge of an expert into a computer-based system that can be used by many people. Expert systems use multiple search models to diagnose a disease. Forward Chaining is a search model that can be used to perform a symptom search of a disease. One of the diseases that can be diagnosed by using computer media is Herpes Zoster. Herpes Zoster is a disease that attacks the skin and mucosa. To provide a degree of certainty to the diagnosis can be used several methods, one of which Bayes Theorem. Bayes's Theorem is a method of calculating certainty that can be used to provide a degree of certainty of diagnosis of a disease by calculating each probability of each of its symptoms. The results of this study is a system that has knowledge such as a doctor to be able to diagnose herpes zoster disease. The diagnostic results obtained from the system will be reinforced by the level of certainty calculated using the bayes theorem.*

Keywords : Expert Systems, Forward Chaining, Herpes Zoster, Bayes theorem.

I. INTRODUCTION

The use of information technology in the world is growing so rapidly that information distribution can reach almost all levels of society. Many media that can be used as a distributor of information, one of which is a computer. Computers have been used in various disciplines of science be it in the arts, physics, health, and so forth. In the field of health, computers have been used to help health practitioners diagnose diseases in humans or other living things, especially in diseases that are difficult to diagnose.

Expert system is a field of science that can process the knowledge of an expert into a computer-based system that can be used by ordinary users [1][2][3][4]. Expert systems use multiple search models to diagnose a disease, Forward Chaining is a search model that can be used to perform symptomatic relief of a disease.

Herpes Zoster (HZ) is a contagious disease caused by reactivation of latent varicella zoster (VZV) virus that is mainly in nerve cells and sometimes in dorsal cellular ganglion satellite cells and sensory ganglion of cranial nerves, spread to the dermatome or accordingly [5].

Herpes Zoster disease attacks the skin and mucosa. This infection is a viral reactivation that occurs after primary infection. This condition provides a striking picture, with vesicles, bulls, crusts, which are firmly bound in the body area. Shingles can appear anywhere in the body, however, more often in the face and around the eyes (herpes zoster optalmika). Some serious complications can occur when present in the area around the eye [6].

In the diagnostic process, the search model performed is forward or forward chaining [7]. This model is used because it is considered capable to provide good search results on the system built. To provide more accurate results then the system is equipped with a method of calculating certainty Bayes Theorem. Bayes theorem is one method of probability that is considered capable to provide the results of calculations that can be used as a reference for certainty of a diagnosis.

II. RELATED WORK

Jatin Patel, et al, "A Research on Expert System using Decision Tree and Naive Bays Classifier" says that expert systems can be used to predict clinical things. For that they initial use examples or raw data of heart patients and extract attributes from that data using decision tree classifier. In next step we generate knowledge base from extracted rules and pass it to inference engine. For working of inference engine we train our model using naive bays classifier. Then prediction model predict class label for user input [8].

Nana Yaw Asabere, Samuel Edusah Enguah, "Integration of Expert Systems in Mobile Learning " says that an expert systems who can use their ability to adapt training to certain students adaptively based on their own learning speed. thus allowing students to gain a deep understanding of the basics to be able to follow topics and courses that are more advanced than CLT 101, and in the fields specified. In addition, the expert system will provide an excellent alternative to personal tutorials and individual training. However, both mobile learning and expert systems tend to use technology [9].

Nidhi Mishra, Dr. P Jha, "A Survey On Fuzzy Medical Expert System" investigate various types of Fuzzy Medical Expert System [FMES] in medical diagnosis and patient

care and show how Fuzzy Medical Expert Systems can help hospitals and doctors improve the quality of care, reduce costs and help with compliance problems [10].

III. RESULT

1. Bayes Theorem

The Bayes theorem [3] is a method that can be applied in a learning machine based on training data, and uses conditional probabilities as a basis. The Bayes theorem is also a method for generating parameter estimates by combining information from samples and other information that was previously available. A key advantage in using Bayes Methods is the simplification of the classical way of integrating to obtain a marginal model [11][12].

a. Probability and Bayes Theorem

Bayes probability is one good way to overcome data uncertainty by using the following formula:

$$P(H|E) = \frac{P(E|H) \cdot P(H)}{P(E)} \quad (1)$$

Information :

$P(H|E)$: probability hypothesis H if given evidence E.

$P(E|H)$: the probability of any evidence appearing.

$P(E)$: probability of evidence E

Bayes's theorem has been widely applied in the logic of modern medicine (Cutler: 1991). The Bayes theorem is more widely used in matters relating to probabilities and possible diseases and related symptoms.

b. Calculations By Bayes Theorem

In general Bayes's theorem with E events and H hypothesis can be written in the form of:

$$P(H_i|E) = \frac{P(E \cap H_i)}{\sum_j P(E \cap H_j)} \quad (2)$$

$$P(H_i|E) = \frac{P(E|H_i) \cdot P(H_i)}{\sum_j P(E|H_j) \cdot P(H_j)} \quad (3)$$

$$P(H_i|E) = \frac{P(E|H_i) \cdot P(H_i)}{P(E)} \quad (4)$$

Bayes theorem can be developed if after testing of the hypothesis then appears more than one evidence. In this case then the equation would be:

$$P(H|E, e) = P(H|E) \frac{P(e|E, H)}{P(e|E)} \quad (5)$$

Information :

e: old evidence

E: new evidence

$P(H|E, e)$: the probability of hypothesis H is true if new evidence E emerges from new evidence E from the old evidence e.

$P(H|E)$: the probability of hypothesis H true if given evidence E.

$P(e|E, H)$: the relation between e and E if hypothesis H is true.

$P(e|E)$: the link between e and E regardless of any hypothesis.

2. Herpes Zoster

Herpes Zoster (HZ) is a contagious disease caused by reactivation of latent varicella zoster (VVZ) that can attack the skin. Factors potentially leading to reactivation are: previous VVZ exposure (chickenpox, vaccination) over 50 years of immunocompromised state, immunosuppressive drugs, HIV / AIDS, bone marrow or organ transplantation, malignancy, long-term steroid therapy, psychological stress, trauma and differentiation measures [1]. The incidence of HZ increases dramatically with age. Approximately 30% of the population (1 in 3) will experience HZ during their lifetime, even at 85 years of age, 50% (1 of 2) will experience HZ. The incidence of HZ in children is 0.74 per 1000 persons per year. This incidence is increased to 2.5 per 1000 people at the age of 20-50 years (adult age) 7 per 1000 people over the age of 60 years (older adult age) and reaching 10 per 1000 people per year at the age of 80 years [5].

Almost 90% will experience pain. Acute pain and chronic pain can disrupt the quality of life. Even based on the measurement of the degree of pain from Katz J & Melzack R literature, acute herpes zoster pain is at a more painful level than in labor pain. Varicella-zoster virus (VZV) is a herpes virus that is the cause of two different diseases: varicella (also known as chickenpox) and herpes zoster (also known as shingles / smallpox / cacar api / dompo).

VZV is a member of the Herpesviridae family, such as herpes simplex virus (HSV) types 1 and 2, cytomegalovirus (CMV), Epstein-Barr virus (EBV), human herpesvirus 6 (HHV-6), human herpesvirus 7 (HHV7), and human herpesvirus 8 (HHV-8).

Varicella virus is a DNA virus, alphaherpesvirus with a large genome of 125,000 bp, sheathed / berenvelop, and 80-120 nm in diameter. The virus encodes approximately 70-80 proteins, one of which is a susceptible thymidine kinase enzyme antiviral drug because it phosphorylates acyclovir so it can inhibit viral DNA replication. The virus infects human cell diploid fibroblasts in vitro, activated T cell lymphocytes, epithelial cells and in vivo epidermal cells for productive replication, and neuronal cells. Varicella virus can form a syncytial cell and spread directly from cell to cell.

The diagnosis of herpes zoster depends on the clinical picture. In patients with Clinical symptoms appropriate to herpes zoster may be performed by laboratory tests although confirmation by performing laboratory tests is usually not indicated. Serologic tests in people exposed to contact are not usually recommended, though possible required in certain circumstances (eg in pregnant women and other high-risk contacts) [13].

3. Requirement Analysis

The designed system will be able to perform advanced trace searches against visible symptoms to obtain a correct disease diagnosis. In addition to providing an appropriate diagnosis, the system also needs to be equipped with the Bayes Theorem as a method of calculating probabilities in order to provide a value of confidence in the results achieved.

Absolute system requirement is needed is symptom data and weight value of each symptom so that can get a good system that can diagnose Herpes Zoster disease with high degree of certainty. The following data on the symptoms of Herpes Zoster disease:

Table I. Indication Data of Herpes Zoster Disease

Code	Indication	Value
G01	Fever	0,6
G02	Cold	0,5
G03	Quick Tired	0,4
G04	Sluggish	0,5
G05	Weak	0,6
G06	Small red spot appears on the skin	0,8
G07	There are small bubbles in the skin	0,9

4. Presentation of Facts and Rules

The presentation of facts and rules used to detect Herpes Zoster is made in the following table:

Table II. Rule

No	Rule
1	<i>IF Fever is True AND Cold is True AND Quick Tired is True AND Sluggish is True AND Weak is True AND Occurs Left Small Spot on Skin is True AND There are small bubbles in the skin is True THEN Herpes Zoster</i>
2	<i>IF Fever is True AND Cold is True AND Quick Tired is True AND Occurs Left Small Spot On Skin is True AND There are small bubbles in the skin is True THEN Herpes Zoster</i>

Based on the table above it can be seen that the two rules are different, of the two rules certainly have different percentage rates of possibilities. because it is necessary to use the Bayes theorem to provide a good level of possibility.

5. System Testing

Testing needs to be done on a study to see the suitability of research with the results to be achieved. If a discrepancy is found, an improvement can be made to the current research.

One of the results of system testing can be seen in the following table.

Table III. Testing Result

Indication	Answer
Are You Experiencing Fever?	Yes
Are You a Cold?	Yes
Are You Tired Quickly?	No
Are you Slim?	Yes
Are You Weak?	No
Is Small Reddish Spot On Your Skin?	Yes
Are There Small Bubbles On Your Skin?	Yes
You are Affected by Herpes Zoster Disease With Percentage Level 73,89%	

IV. CONCLUSION

Based on the research and discussion conducted, it can be concluded as follows:

1. By using the forward chaining tracing model then the Herpes Zoster disease analysis process can be done, so it will produce a rule base that can be used to trace the disease based on apparent symptoms.
2. The use of the Bayes Theorem as a method of calculating the probability based on the symptoms is considered good enough to produce a high value of trust.
3. Applications designed to have the ability to calculate the value of symptoms of weight using bayes theorem and in accordance with the results of calculations manually, so it can be used as a value of certainty for the diagnosis.

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