



Expert System Diagnosing Heart Disease using Bayes' Theorem Method

Cahaya Ningsih

Program Studi Teknik Informatika, STMIK Pelita Nusantara, Medan, Indonesia

Article Info

Article history:

Received Jul 06 30, 2020

Revised Jul 22, 2020

Accepted Aug 14, 2020

Keywords:

Heart disease;

Bayes' Theorem Method;

PHP;

MySQL;

WEB.

ABSTRACT

Heart disease is one of the leading causes of death in Indonesia. The high number of deaths from heart disease is caused by the lack of cardiologists, the lack of public awareness of conducting regular heart health checks and the poor lifestyle of patients. So we need an application that can make it easier for users to detect heart disease early and independently. In this study, the aim is to build an application using the website-based Bayes Theorem method as a tool for diagnosing coronary heart disease. In this application, patients do not have to wait long for treatment by a doctor, but it can be an alternative to anticipate treatment quickly and precisely. How to use this application, the admin inputs questions in the form of symptoms that will be answered by the user, then the system will process all user answers using the Bayes theorem method and the system will issue output in the form of diagnostic results in the form of heart disease and various solutions. This application uses a Web programming language and Php & Mysql as a database. The system that has been built can assist patients in knowing the type of heart disease that is being suffered by the patient and according to the analysis of heart disease experts.

This is an open access article under the [CC BY-NC](https://creativecommons.org/licenses/by-nc/4.0/) license.



Corresponding Author:

Cahaya Ningsih,

Program Studi Teknik Informatika,

STMIK Pelita Nusantara, Medan, Indonesia

E-mail: cahayaningsih@gmail.com

1. INTRODUCTION

The development of information and communication technology is inseparable from developments in the field of computer technology that encourage the use and utilization of these technological developments widely in various fields and aspects of life [1]. One example of the utilization and use of the development of computer technology itself is in science. In biology, there are various branches of science, one of which is Phytopathology, which is a branch of science that studies heart disease due to blockages in the coronary arteries [2] [3]. By using technology, heart disease can be diagnosed easily of course by using knowledge related to the symptoms studied.

The heart is one of the vital organs for living things. In humans, like other living things, the heart functions to pump blood throughout the body [4] [5]. Because the function of the heart is very important for humans, heart health is very important. The heart is very susceptible to various

diseases and disorders that can interfere with activities and even cause death. Diseases and heart disorders are often not felt or known to the sufferer. Sometimes it is discovered after the disease is severe or life-threatening [6] [7] [8]. The problems faced are the lack of public understanding of the symptoms of heart disease, there are still few experts in the field of heart disease, many people ignore the dangers of heart disease, resulting in an increasing mortality rate.

Expert system is one of the fields of computer science that utilizes computers so that they can behave intelligently like humans. This system seeks to adopt human knowledge to computers, so that computers can solve problems as is usually done by experts. The expert system will provide a list of symptoms until it can identify an object based on the answers received [9] [10] [11].

Bayes method is one way to overcome data uncertainty by using the Bayes formula [12]. In this study, the Bayes method will be used in the design of an expert system for diagnosing heart disease because the Bayes method requires information in the form of probability values for each alternative in the problem at hand which will produce an expected value as a basis for decision making.

With this software, it is expected to be able to assist the public in diagnosing whether a person is at risk of coronary heart disease and provide advice as early as possible without large costs.

2. RESEARCH METHODS

To obtain data in the form of information about the types of heart disease and their symptoms, the researchers conducted direct observations and interviews with a specialist in heart disease at the Aviati Clinic. As for an expert, namely dr. Lita Feriyawati M.Kes., SP., PA as a heart disease specialist. Aviati Clinic Medan on July 28 2018. In addition, based on the advice of the expert, the author is looking for other references to expand knowledge about the heart from trusted books or literature.

2.1 Method of collecting data

The stages and methods of data collection carried out in writing this final project are:

a. Observation

This observation method is used to find out and observe directly the object being studied. The object of research is diagnosing heart disease at the Aviati clinic.

b. Interview

Interview is a method that is carried out by asking questions or asking questions directly to dr. Lita Feriyawaty M.Kes., SP., PA, an expert who has experience in the field of heart disease.

c. Study of literature

The literature study carried out is a method of collecting data by reading and comparing literature, most of which comes from book articles, the internet and experts. The literature deals with heart disease.

3. RESULTS AND DISCUSSION

3.1 Bayes method analysis

The Bayes method is a statistical approach to calculating trade offs between different decisions, using the probability value that accompanies a decision [13]. Bayes method is used to calculate the certainty of data into definite data by including the percentage. Bayes method or theorem is used more for matters relating to statistical diagnosis related to the probability or probability of the disease and related symptoms [14] [15]. The Bayes formula can be seen as follows:

$$P(H | E) = \frac{P(E | H) \cdot P(H)}{P(E)} \text{ or } P(H | E) = \frac{P(H \cap E)}{P(E)} \dots\dots\dots (1)$$

Description:

- P (H | E): the probability of the hypothesis if given evidence E
- P (E | H): probability of the emergence of evidence E if the hypothesis H . is known
- P(H) : probability H regardless of any evidence
- P(E) : probability evidence E

According to Vonny Pawaka, the steps in applying the Bayes method in an expert system are to input the symptoms known to the user, then look for the universal value by adding up the probabilities of each symptom experienced or can be formulated with the following formula:

$$\sum_{i=1}^n = P (E|H1)+ P (E|H2) + \dots + P (E|Hn) \dots\dots\dots (2)$$

After knowing the results of the sum above, then calculate the probability value of the hypothesis H regardless of any symptoms/evidence, as follows:

$$P(H1) = \frac{P(E |H1)}{\sum_{i=1}^n (P (E |Hi))} \dots\dots\dots (3)$$

After knowing the results of P (Hi) or the probability of the hypothesis regardless of any symptoms, then the next step is to calculate the probability value of E evidence with the following formula:

$$P(E) = \sum_{k=0}^n = P (Hi) * P (E|Hi) \dots\dots\dots (4)$$

After getting the value of the probability of evidence E, the next step is to calculate the Bayes value of each hypothesis with the following formula:

$$P (H1|E) = \frac{P(E |H1)*P(H1)}{P(E)} \dots\dots\dots (5)$$

After getting all the values of P (Hi | E), the next step is to calculate the total Bayes value with the following formula:

$$\sum_{n=1}^n Bayes i = Bayes 1 + Bayes 2 + Bayes n \dots\dots\dots (6)$$

And the last step is to calculate the percentage of the total Bayes value with the following formula:

$$Percentage = \sum_{i=1}^n Bayes i * 100\% \dots\dots\dots (7)$$

2.2 Data analysis

The following is the disease data found in the heart, which contains the disease code and name/type of disease:

Table 1.Disease Data

Disease Code	Disease Name
Po1	Coronary heart disease
Po2	Rheumatic Heart Disease
Po3	Heart Failure
Po4	Heart Valve Abnormalities
Po5	Leaky Heart Disease
Po6	Abnormalities in the heart muscle
Po7	Heart Arrhythmia Disease
Po8	Congenital Heart Disease

Table 2.Symptom Data

Symptom Code	Symptom	Bayesian Probability Value
G1	A blockage in the coronary arteries is called chest pain	0.8
G2	Shortness of breath in the chest	0.7
G3	Weight gain	0.9
G4	Tired easily	0.5
G5	Irregular cholesterol	0.6
G6	Lips or nail tips are bluish	0.9
G7	Shortness of breath in the chest	0.7
G8	Swelling in the abdomen and legs	0.8
G9	Blue nails on the hands and feet	0.7
G10	Swelling of the feet and hands	0.8
G11	Out of breath	0.5
G12	Out of breath	0.7

Symptom Code	Symptom	Bayesian Probability Value
G13	Feeling pain in the chest	0.6
G14	Fatigue	0.3
G15	Easy to get tired	0.5
G16	Out of breath	0.7
G17	Excessive headaches	0.9
G18	Tired all the time	0.8
G19	Valve leak in the wall	0.8
G20	The heart stops suddenly	0.9
G21	Weakness in the heart muscle	0.7
G22	Pounding feeling in the chest	0.8
G23	Irregular breath	0.6
G24	Excessive headaches	0.9
G25	stunted growth	0.9
G26	Slower beat	0.6
G27	Breath becomes fast and short	0.8

Table 3.Disease Data and Solutions

Disease Code	Disease Name	Reason	Solution or Control
Po1	Coronary heart disease	Because there is a blockage in his hard heart because it is covered by fat.	- always maintain a regular diet and exercise
Po2	Rheumatic Heart Disease	Inflammation of the minisitis in the throat	Exercise regularly, always drink lots of water
Po3	Heart Failure	Can not be pumped anymore because the heart is filled with fluid.	Less burden on the heart
Po4	Heart Valve Disease	Because the heart is congenital from birth, the result is high blood pressure and can damage the nerves of the heart valves.	His high blood pressure must be controlled and take medication regularly
Po5	Leaky Heart Disease	There is a leak from the valve wall	Reduce high blood pressure and take medication regularly
Po6	Disease Abnormalities On Cardiac muscle	Damage to Heart Tissue	Cells in cardiac muscle tissue have an elongated cylindrical shape with both ends
Po7	Disease Heart Arrhythmia	Side effects of taking the drug	The amount of eating drugs - illegal drugs so that addiction can occur in the body
Po8	Congenital Heart Disease	Diabetes And Drug Addiction	Due to the population of inhaled air is not healthy, so starting with a normal cough so that it lasts a long time can lead to diabetes

2.3 Bayes Value and Conclusion Percentage

As for the logic of the Bayes theorem method in the system consultation session, the user is given a choice of answers that have their respective weights such as table 3.5 and table 3.6 for the percentage of the conclusion of the disease.

Table 4.Bayes value

Terminology of certainty	A/B
Not sure	0
Do not know	0.2
Not sure	0.4
Sure enough	0.6
Not sure	0.8
Certainly	1

Table 5. Conclusion Presentation

Percentage Level	Possible Value
0-50%	Little Possibility Or small
51-79%	Possibility
80-99%	Most likely
100%	Very sure

4. CONCLUSION

Based on the results of the theoretical discussion on the design of an expert system that diagnoses heart disease, it can be concluded that; The expert system uses the Bayes theorem method to diagnose the risk of heart disease based on risk factors and symptoms that affect the level of risk of heart disease in each patient. The system design in this study aims to explain the system design using the UML modeling language (Unified diagrams, class diagrams, activity diagrams, sequence diagrams).

REFERENCES

- [1] D. Setiawan, "Dampak perkembangan teknologi informasi dan komunikasi terhadap budaya," *J. SIMBOLIKA Res. Learn. Commun. Study*, vol. 4, no. 1, pp. 62-72, 2018.
- [2] N. NADHIROH, "PENGARUH MODEL PEMBELAJARAN INQUIRY TERHADAP HASIL BELAJAR BIOLOGI MATERI SISTEM PEREDARAN DARAH SISWA KELAS VIII DI MTS. MA'ARIF BAKUNG UDANAWU BLITAR TAHUN AJARAN 2018/2019," 2019.
- [3] T. A. Wihastuti, S. Andarini, and T. Heriansyah, *Patofisiologi Dasar Keperawatan Penyakit Jantung Koroner: Inflamasi Vaskular*. Universitas Brawijaya Press, 2016.
- [4] M. Iskandar, *Health Triad*. Elex Media Komputindo, 2013.
- [5] M. Suwardi, *Rahasia Dibalik Penciptaan Organ Tubuh Manusia*. 2015.
- [6] R. Bahana, I. Indrajani, R. Kosala, and Y. Heryadi, "Aplikasi Informasi Kesehatan Dan Diagnosa Penyakit Jantung Berbasis Android," in *Seminar Nasional Teknologi Informasi Komunikasi dan Industri*, 2018, pp. 10-16.
- [7] A. S. Sitio, "Sistem Pakar Untuk Mendiagnosa Penyakit Jantung Menggunakan Metode Dempster Shafer," *J. Inform. Pelita Nusant.*, vol. 3, no. 1, 2018.
- [8] R. E. Kowalski, *Terapi hipertensi*. PT Mizan Publika, 2010.
- [9] H. T. Sihotang, E. Panggabean, and H. Zebua, "Sistem Pakar Mendiagnosa Penyakit Herpes Zoster Dengan Menggunakan Metode Teorema Bayes," *J. Inform. Pelita Nusant.*, vol. 3, no. 1, 2018.
- [10] Y. I. Za'im, "Sistem Pakar untuk Diagnosa Penyakit Jantung Koroner Menggunakan Metode Perceptron," *Skripsi, Fak. Ilmu Komput. Univ. Dian Nuswantoro*, 2013.
- [11] L. Hoki, "Perancangan Sistem Pakar Diagnosa Ispa Dengan Metode Forward Chaining," *J. TIMES*, vol. 8, no. 1, pp. 63-72, 2019.
- [12] S. Winiarti, "Pemanfaatan Teorema Bayes dalam Penentuan Penyakit THT," *J. Inform.*, vol. 2, no. 2, pp. 189-198, 2008.
- [13] V. Pawaka, "Sistem Pakar Deteksi Diabetes Mellitus Menggunakan Metode Bayesian Berbasis Web," *JUSTIN (Jurnal Sist. dan Teknol. Informasi)*, vol. 3, no. 2, pp. 39-43.
- [14] A. J. F. Purba, "Perbandingan Metode Bayes Dan Certenty Factor Pada Sistem Pakar Mendiagnosa Penyakit Varisela Pada Anak-Anak," *Heal. Contemp. Technol. J.*, vol. 1, no. 1, pp. 20-25, 2020.
- [15] H. Pramudia and A. Nugroho, "Sistem Informasi Kerusakan Laptop Menggunakan Metode Naive Bayes," *Teknol. Elektro, Univ. Mercu Buana*, vol. 5, no. 2, pp. 135-155, 2017.