INTRODUCTION

Autoimmune is a problematic type of disease to detect due to the similarity of its symptoms to several other types of diseases (D. Setiawan, Putri, and Suryanita 2019). Autoimmunity is a disorder of the immune system that results in the failure of the body’s defense of stability, causing losses because it can damage the organs of cells that are still healthy in a person’s body (R. Setiawan, Suhery, and Bahri 2018). Autoimmune diseases can cause symptoms to affect the human immune system and attack the body (Permata Sari 2019). Based on medical records at the Internal Medicine Unit at Tanjungbalai Hospital, there are 7 types of autoimmune diseases, including ITP (Idiopathic Thrombocytopenic Purpura), SLE (Systemic Lupus Erythematosus), Type 1 DM, Graves Disease, RA (Rheumatoid Arthritis), Autoimmune Hepatitis, and Hashimoto’s Thyroiditis. This study resulted in ITP with an accuracy rate of 98%, SLE with an accuracy rate of 96%, Diabetes Mellitus Type 1 with an accuracy rate of 96%, Graves Disease with an accuracy rate of 93%, RA (Rheumatoid Arthritis) with an accuracy rate of 99%, Autoimmune Hepatitis with a 94% accuracy, and Hashimoto’s thyroiditis with 99% accuracy.

Keywords: autoimmunity, expert system, dempster-Shafer
One branch of artificial intelligence is an expert system, which uses special knowledge from an expert or experts to solve a particular problem (Christy 2018). Someone who has special skills and can solve problems that cannot be solved by the community is called an expert (Aldo, Putra, and Riau 2020). Part of the expert system, namely the consulting environment and development environment (PANESSAI 1375).

The purpose of an expert system is to imitate the thought process and transfer knowledge from an expert in a particular field to a computer so that it can replace the task of an expert when the expert is not in place. To detect these autoimmune diseases, an expert system was created to assist the public in making early detection and knowing the types of autoimmune diseases through some of the symptoms experienced by patients.

The author uses the Dempster Shafer method in the detection of autoimmune diseases. Dempster Shafer is used to calculating inconsistencies due to the addition or subtraction of new facts that will change existing rules. The Dempster Shafer calculation process is carried out based on the expert’s confidence value of the symptoms of a disease and can calculate the probability of all possible diseases from each symptom (MZ, Wijaya, and Bimantoro 2020). Dempster Shafer is written with the interval [Trust, Reasonable]. Confidence (Bel) is a measure of the strength of evidence. A value of 0 indicates no evidence, a value of 1 indicates certainty. Reasonable (Pl) Reasonable is also 0 to 1" (Kirman1, Andika Saputra2 2019). The density function (m) defines the elements and all their subsets for which we need probabilities (Handayani Mugirahayu, Taufiq 2016). The results provided by the system must be those given by experts so that this certainty calculation can convince the user (patient) (Dina Hastari* 2018).

Types of research

Through detailed and in-depth data collection, a qualitative approach involves various sources of information such as observations, interviews, and documents from various reports (Sulistiono 2019). The method used in this research is the qualitative method. The data collection technique was carried out by observing at the Tanjungbalai Poly Internal Medicine Hospital and asking directly to the related parties to receive explanations, observation notes, interview results, and other documents.

Research Time and Place

This research has received ethical approval from the Director of RSUD Tanjungbalai No. 805/10697/RSUD. The study began on December 23, 2021 at the Dr. Tengku Mansyur, better known as the Tanjungbalai Regional General Hospital, located on Jln. Maybe. General Sutoyo No.39, Officer, South Tanjungbalai, Tanjungbalai City, North Sumatra 21313.

Data collection technique

Data collection techniques used in this study include:

1. Interview

An interview is a conversation carried out by two people with a specific purpose (Dr. Umar Sidiq, M.Ag Dr. Moh. Miftachul Choiri 2019). The author conducted interviews with a doctor or professional expert in the treatment of autoimmune diseases, a specialist in Internal Medicine, namely (Dr. Abdul Jalil Rambe) this interview aims to obtain in-depth data about autoimmune and ensure that the data
obtained are truly accurate both from exposure early symptoms to solutions in the prevention of autoimmune diseases.

2. Study of literature
   Studying previous and similar research on autoimmune diseases, by collecting data from various literature sources in the form of scientific journals, theses, papers, books, internet (website).

3. Documentation
   Data collection was obtained through patients with autoimmune diseases at the Internal Medicine Unit at Tanjungbalai Hospital.

Data analysis technique
   Descriptive data analysis by categorizing one of the data analysis techniques (Lamada, Rahman, and Herawati 2019). Several autoimmune diseases found in the medical records of inpatient morbidity data at Tanjungbalai Hospital for the period 2018 to 2020 include ITP (Idiopathic Thrombocytopenic Purpura), SLE (Systemic Lupus Erythematosus), Type 1 DM, Graves Disease, RA (Rheumatoid Arthritis), Autoimmune. Hepatitis and Hashimoto's thyroiditis.

RESULTS AND DISCUSSION

Knowledge-Based
   The knowledge base in research provides much information about various objects such as patients, diseases, and so on (Wahyudi and Akbar 2019). The results of the interviews are shown in table 1.

| Disease Code | Disease Name                          | Weight |
|--------------|---------------------------------------|--------|
| P01          | ITP (Idiopathic Thrombocytopenic Purpura) |        |
| P02          | SLE (Systemic Lupus Erythematosus)     |        |
| P03          | Diabetes Mellitus Type 1               |        |
| P04          | Graves Disease                        |        |
| P05          | RA (Reumatoid Arthritis)              |        |
| P06          | Autoimmune Hepatitis                  |        |
| P07          | Hashimoto's thyroiditis               |        |

Table 1 is disease data obtained from medical records at Tanjungbalai Hospital, and this table contains disease codes and 7 types of autoimmune diseases.

| Disease Code | symptom            | Weight |
|--------------|--------------------|--------|
| G01          | Nosebleed          | 0.2    |

Table 2 is the symptom data of autoimmune diseases containing the symptom codes, symptoms, and weights given directly by the expert, namely the doctor on duty at Tanjungbalai Hospital, Internal Medicine Specialist, namely (Dr. Abdul Jalil Rambe).

The formation of rules is a rule in making decisions regarding diseases and symptoms obtained from experts, namely because there are 7 diseases, and there will be 7 rules as follows:

RULE 1 = IF G01 AND G02 AND G03 AND G04 AND G05 THEN P01
Thrombocytopenic Purpura, with a 98% confidence level.

b. SLE (Systemic Lupus Erythematosus) (P2)

The symptoms selected by the patient are as follows.
1) Shortness of breath
2) Weight loss
3) Joint swelling
4) Headache

Then get the following results:
Shortness of Breath (G6):
- P1 (0.4) 0 (0.6)
- P1-P7 (1) 0.4 0.6

Weight Loss (G6):
- P2 (0.2) 0 (0.8)
- P2 (0.4) 0.08 0.32
- P1-P7 (0.6) 0.12 0.48

Joint Swelling (G6):
- P2 (0.6) 0 (0.4)
- P2 (0.52) 0.312 0.208
- P1-P7 (0.48) 0.288 0.192

Headache (G9):
- P2 (0.6) 0 (0.4)
- P2 (0.808) 0.6464 0.1616
- P1-P7 (0.192) 0.1536 0.0384

From these calculations, it can be concluded that the most accurate is SLE (Systemic Lupus Erythematosus), with a 96% confidence level.

C. Diabetes Mellitus Type 1 (P3)

The symptoms selected by the patient are as follows.
1) Frequent urination
2) Often thirsty
3) Tingling
4) Often feel hungry
5) Nearsightedness

Then get the following result:
Frequent Urination (G10):
- P3 (0.6) 0 (0.4)
- P1-P7 (1) 0.6 0.4

Symptoms of Excessive Fatigue (G11):
- P3 (0.6) 0 (0.4)
- P3 (0.6) 0.36 0.24
- P1-P7 (0.4) 0.24 0.16

From these calculations, it can be concluded that the most accurate is ITP (Idiopathic Thrombocytopenic Purpura).
| Condition          | Symptoms Selected | P3, P5 (0,4) | P1-P7 (0,16) | P1-P7 (0,28) | P4 (0,4) | P1-P7 (0,1152) |
|--------------------|-------------------|---------------|--------------|--------------|---------|----------------|
| Tingling Symptoms (G12) | P3, P5 (0,4) | 0,336 | 0,064 | 0,064 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
| Tingling (G12) | P3, P5 (0,4) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Often feel hungry (G13) | P3 (0,6) | 0,504 | 0,0384 | 0,0576 | 0,0384 | 0,0256 |
| Myopic (G14) | P3 (0,4) | 0,3744 | 0,0102 | 0,0154 | 0,0384 | 0,0256 |
| From these calculations, it can be concluded that the most accurate is Graves Disease, with a 93% confidence level. |
From these calculations, it can be concluded that the most accurate is RA (Rheumatoid Arthritis), with a 99% confidence level.

e. Hashimoto’s thyroiditis (P7)
The symptoms selected by the patient are as follows.
1) Easily tired and tired
2) Weight gain
3) Cholesterol levels increase
4) Dry skin
5) Irregular menstruation

Then get the following results:

1) Joint pain
2) Fatigue
3) Loss of appetite
4) Nausea and vomiting
5) Skin rash

From these calculations, it can be concluded that the most accurate is Autoimmune Hepatitis, with a 94% confidence level.

Then get the following results:

1) Joint pain
2) Fatigue
3) Loss of appetite
4) Nausea and vomiting
5) Skin rash

From these calculations, it can be concluded that the most accurate is Hashimoto’s Thyroiditis, with a 99% confidence level.

| No | Disease Name          | Results |
|----|-----------------------|---------|
| 1. | Thrombocytopenic Purpura | 98%     |
| 2. | SLE (Systemic Lupus Erythematosus) | 96%     |

| Table 3. Results |
|------------------|
| No | Disease Name | Results |
|----|--------------|---------|
| 1. | ITP (Idiopathic Thrombocytopenic Purpura) | 98%     |
| 2. | SLE (Systemic Lupus Erythematosus) | 96%     |
No | Disease Name                  | Results |
---|-------------------------------|---------|
3  | Diabetes Mellitus Type 1      | 96%     |
4  | Graves Disease               | 93%     |
5  | RA (Rheumatoid Arthritis)    | 99%     |
6  | Autoimmune Hepatitis         | 94%     |
7  | Hashimoto’s thyroiditis      | 99%     |

Table 3. The final results of each type of the disease are calculated using the Dempster Shafer method.

System Implementation

The stages of the design after which the system is implemented to ensure the system is by design made.

1. Web Main Page Display

Figure 2 is the main web page display where the user first accesses the system. Users can access other menus, such as the about menu, containing information about Tanjungbalai Hospital, menu lists, and login menus.

2. Consultation Page View

Figure 3 Consultation page display displays where the user performs a consultation to check for diseases on the system. This page contains a selection of autoimmune symptoms that the user will carry out.

3. Display of Disease Check Results Page

Figure 4 page display of disease examination results is a display where the user sees the results of the disease examination on the system based on several selected symptoms, and then the system will carry out the calculation process and display the percentage value of the type of disease that is more dominant and the solution for each type of disease. The disease test results page can be printed by clicking the red print menu in the lower-left corner of the page.

CONCLUSIONS AND SUGGESTIONS

Conclusion

The results of the application of the Dempster Shafer method in an expert system for detecting autoimmune diseases based on the symptoms that have been carried out then obtained the results of ITP (Idiopathic Thrombocytopenic Purpura) with an accuracy of 98%, SLE (Systemic Lupus Erythematosus) with an accuracy of 96%, Diabetes Mellitus 1 with an accuracy of 96%, Graves Disease with 93% accuracy, RA (Rheumatoid Arthritis) with 99% accuracy, Autoimmune Hepatitis with 94% accuracy, and Hashimoto’s Thyroiditis with 99% accuracy. And the results of designing an expert system that can detect autoimmune diseases in Tanjungbalai Hospital so that patients get accurate results using the PHP programming language can facilitate the process of early detection of autoimmune diseases quickly and accurately by the application of the Dempster Shafer method so that it can be used as a reference in detecting diseases as early as possible. Suffered by the patient without having to come to the hospital. General Tanjungbalai and his system also provide solutions for detecting autoimmune diseases.
Suggestion
After the author has finished carrying out the research process, the author would like to suggest to the reader that it is hoped that there will be developed if there is similar research on Autoimmune Disease Detection with Dempster Shafer at Tanjungbalai Hospital, such as adding types of autoimmune diseases, disease information, and other experts so that research on Autoimmune Disease Detection with Dempster Shafer is carried out in Tanjungbalai Hospital is complete. And it is hoped that Autoimmune Disease Detection research can be developed with other methods so that a higher level of accuracy can be obtained and a comparison of the methods to be used can be made.

REFERENCE LIST

Aldo, Dasril, Sapta Eka Putra, and Kepulauan Riau. 2020. "Sistem Pakar Diagnosis Hama Dan Penyakit Bawang Merah Menggunakan Metode Dempster Shafer Expert System for Diagnosis Pests and Shallots Diseases Using Dempster Shafer Method." STMK Royal 15(1): 353–58.

Christy, Tika. 2018. "Implementasi Sistem Pakar Diagnosa Penyakit Cabe Menggunakan Metode Forward Chaining." STMIK Royal 15(1): 35–58.

Setiawan, Debi, Ramalia Noratama Putri, and Reni Suryanita. 2019. "Implementasi Algoritma Genetika Untuk Prediksi Penyakit Autoimun." Jurnal Coding, Sistem Komputer Unutar 06(03): 97–106.

Sihotang, Hengki Tamando et al. 2018. "Sistem Pakar Mendiagnosis Penyakit Herpes Zoster." Jurnal Of Informatic Publik Indonesia 3(1).

The work is distributed under the Creative Commons Attribution-NonCommercial 4.0 International License