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Expert System for Diagnosing Newborn Babies Disease Using the Sorgenfrei Similarity Method

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ABSTRACT

Newborn neonates who are 0-28 days old. At that time the baby has a physical condition that is very weak and helpless to the surrounding environment. Newborns need special handling different from babies at the age of 1 month also above. Diagnosis also treatment is quickly required by the midwife in an emergency. Without there are still many midwives who have not been able to handle it properly, causing the baby's condition to become worse. To get fast and accurate handling information, we need a system in the form of an expert system. Expert systems can diagnose newborn diseases using the Sorgenfrei similarity algorithm. The system can display information about the type of disease, symptoms, solutions, and the percentage of similarity from the results of consulting the symptoms input. The results of testing the system with the consultation of the symptoms included got the highest percentage of similarity results 53.33%. The percentage of similarity results below 20% will be entered into the revised table which will later be corrected by experts. This expert system is built based on a website that can be accessed by all midwives who need handling information

I. INTRODUCTION

Neonatal is defined as a clinical syndrome in aninfant 28 days of life or younger[1].Newborn children screening is a must for examining every newborn for persuaded dangerous or potentially deadly disorders that aren't otherwise obvious at birth[2]. Weightless or below average becomes a problem that often occurs in newborns. In an emergency, diagnosis and help are needed quickly. Delay in providing help can result in death to the baby. In 2012 the number of neonatal infant deaths was 19 deaths per 1000 live births. In 2017

Lack of adequate health facilities, inadequate diagnosis, and still minimal human resources in the field of health, causes a high rate of newborn mortality. These events, more frequently caused by improper intrauterine transfer of maternal blood oxygen to the fetus resulting in an acute inadequate supply of oxygen to the fetal organs and tissues[4]. Data collection starting from handling pregnancy, managing data of health workers, managing information on pregnancy problems by the community, delivery by medical personnel and neonatal visits need to be managed properly to produce information about good handling so that neonatal recovery can be adjusted by taking action - appropriate measures for neonatal issuance based on information data that has been generated with these problems, the authors want to create an expert system that is useful for diagnosing newborn diseases.

In the case of report submission, there is a problem caused by the delay in submission of the report which causes the data obtained is not up to date, so the decision [illegible] inaccurate.To provide information about the disease accurately and precisely needed a system that can do this simultaneously. The most appropriate system used for this problem is the expert system.

Expert systems are computer programs that are derived from a branch of computer science research called Artificial Intelligence (AI)[5]. Expert systems are used to solve a large number of problems such as decision-making[6]. Computer-based systems using

knowledge, facts and reasoning techniques for an expert to solve problems. The inference engine applies the rules to known facts to deduce new facts [7].From the problem the current proposed expert system is specialized in the diagnosis ofdisease in newborns [8].

II. RESEARCH METHODS

A. Similarity Algorithm

A similarity algorithm is a way to calculate the similarity of two objects by comparing the similarity based on syntax or semantic values. The coefficient is adopted to display the quantity of similarity. Algorithms for solving many pattern recognition problems such as classification, clustering, and data retrieval problems for more details can be seen in Table1.

TABEL I
SIMILARITY FORMULA

	1 (*presence*)	**0 (*Absence*)**
1 (*presence*)	a = i.j	b = $\overline{i}$. j
0 (*Absence*)	c = i . $\overline{j}$	d = $\overline{i}$. $\overline{j}$

Information:
a = number of attributes where the values of i and j are equal to 1 (presence), which means positive matches
b = number of attributes where the values of i and j are (0,1), which means i absence mismatches
c = number of attributes where the values of i and j are (1,0), which means j absence mismatches
Similarities usually fall in the range of 0 to 1, where 0 there are absolutely no matching or similar cases, and a value of 1 means that it has a 100% match.

B. Similaritas Sorgenfrei

The similarity is a measure of the closeness of an object with other objects. Then what is meant by Sorgenfrei similarity is the method used to calculate the similarity between the distance of two probability distributions with the formula referred to in equation (1).

$$S=\frac{a^2}{(a+b)x(a+c)} \quad (1)$$

Information:
S = Value Similarity
a = The same number of attributes between consultation and data stored in the database.
b = The amount of data stored in the database, which is not in the consultation.
c = Number of consulting data attributes, which are not stored in the database.

C. System Description

Website-based expert system for newborns using the Sorgenfrei method. This application allows users to view newborn disease information. To start the application process, it is divided into two access rights, namely user and admin. The user can consult with the selected symptoms experienced by the baby. While the admin can make a consultation like a user plus the admin can input information, symptoms, and diseases.

In implementing this child expert system, it takes 4 stages of the process, namely retrieve, reuse, revise, and retain. The retive process is the process of finding data in a database with method sorgrenfrei. Then the reus system process that provides the results of the calculation of the greatest similarity value will be used as a solution to the disease. Furthermore, in the process of revisingprocess of revising the values that come out of the proposed solutionreus process that still does not meet the requirements will be accompanied in a special table, for later repaired experts to find the right solution [9]. After the revision process is finished and the most appropriate solution is found, the expert will add the relation to the relation table which can later be used for solving similar cases in the future [10].

Admin's work process begins with logging in to the login page, then the admin will be directed to a display that has a choice of menus, illnesses, symptoms, solutions, and relationships to maintain data and information. For more clearly how the system works User work system architecture can be seen in Picture 1, while the admin work systemarchitecture can be seen in Figure 2

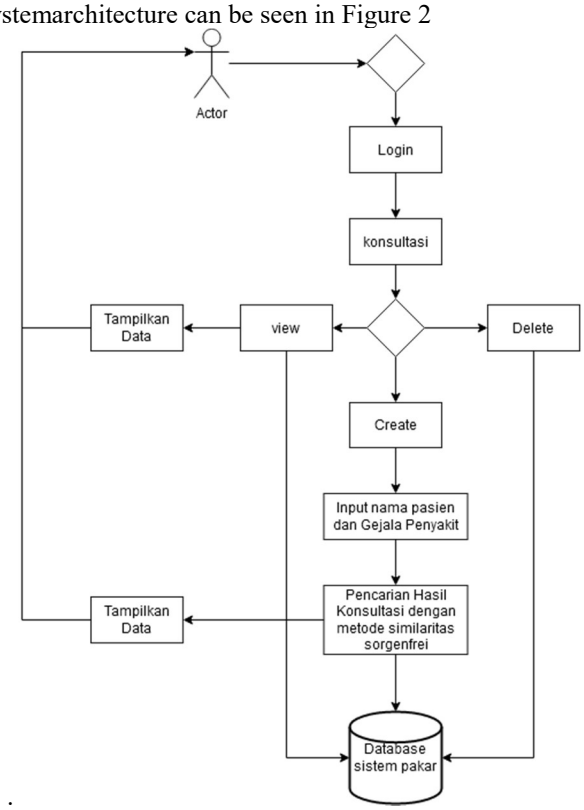

Fig.1 User system architecture.

The picture above explains the flow of the user's role in using the system to consult newborn diseases

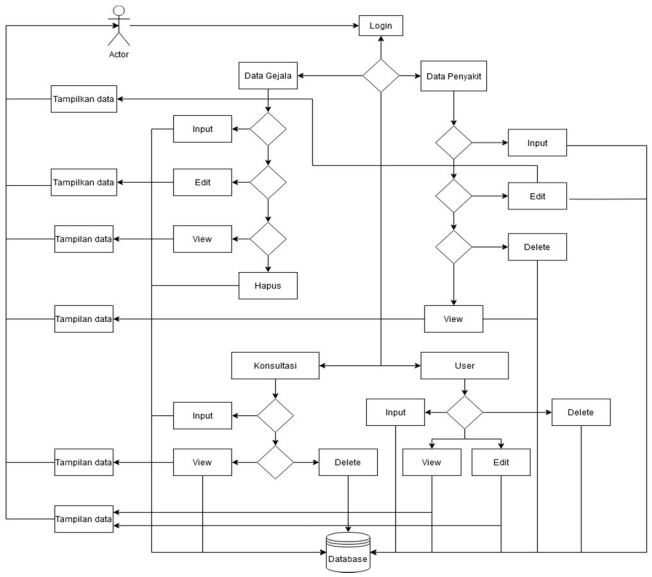

Figure 2.Admin system architecture.

In the figure 2 above is an admin role that can access all the menus or features that are in the system created.

D. Knowledge Representation

The symptoms table is used as a knowledge base that will be compared with many symptoms, both those that have been recorded and those that have never been recorded. This database is used as a basis for comparing a user's consultation with a pre-existing knowledge base. In the symptom table, there is a symptom code that shows the sequential number of symptoms and the name of the disease symptoms that exist in newborns. For more details, can be seen in Table 2.

TABLE II
NAME OF SYMPTOMS

Symptom Code	Name Symptoms
G01	Jaundice occurs on days 2 and 3
G02	Extreme movements are not active
G03	yellow eye sclera
G04	the baby won't suckle
G05	yellow baby jaundice 24 hours after birth
G06	stay for 7-14 days
G07	jaundice of yellow baby accompanied by LBW (BW <2500 gram), infection
G08	Difficulty defecating
G10	Hard stool
G11	Stomach hard or palpable stool mass on the abdominal wall
G12	Pain in the anal area
G13	Fresh blood comes out due to anal injury.
G14	BAB> 4x / day
G15	Unconscious
G16	Sunken eyes
G17	Restless / fussy
G18	Non-elastic skin (pinch the skin of the stomach's slow return)
G20	Diarrhea persists for 2 weeks
G21	Acute gastroenteritis in infants aged> 3 months
G22	Clinical syndromes
G23	Active movement (looking healthy)
G24	Self limited disease
G25	Responsifterhadapterapisuportif yang diberikan (kesadaranbaik)
G26	Cough
G27	Sometimes sneezing
G28	Secretions from the nose (runny nose)
G30	Body weight at birth LBW = 1500 - 2499 grams
G31	Body weight at birth BBLSR = 1000 - 1499 grams
G32	Weight at birth BBLER = <1000 grams
G33	Body length <45 cm
G34	Head circumference <32 cm
G35	Chest circumference <30 cm
G36	Inactive movements (hypotonic muscles)
G37	Head bigger than body, thin and fine hair
G38	Soft skull bones
G39	Simple-shaped ears and little cartilage
G40	small / not formed nipples
G41	breathing <20x / minute
G42	Thin, transparent skin, lanugo (fine hair), especially on the forehead, forehead temples and arms, visible blood vessels
G43	Genetalia is not perfect, in women the labia minor has not been covered by labia majora, the clitoris protrudes. In small scrotal LK men, the testes are not palpable
G44	Reflexes suck, swallow and cough weak
G45	Edema Extremities (swelling)
G46	Convulsions
G47	Fever (temperature> 37.5ºC)
G48	Irregular eye movements
G49	Throw up
G50	The movements of the hands and feet (extremities) are not active
G51	Pain in the head and back
G52	Baby reflex is absent
G53	Cry loud and high pitch
G54	Decreased appetite
G55	Occurs 6-72 hours after birth
G56	Respiratory disorders
G57	Pale / blue baby
G58	Jaundice / jaundice
G59	Diarrhea
G60	Bloated
G61	No response
G62	Release the ties or clamps of the cord that is still attached
G63	Redness on the umbilical cord
G64	There is a secret on the umbilical cord

G65	Slimy cough
G67	Rapid baby breathing> 60x / minute (tachypnea)
G68	Hypertherm (temperature> 37.5ºC)
G69	Nausea
G70	Urinating is not as usual
G71	Trismus (difficulty opening the mouth) is mild
G72	Stiff / inelastic skin
G73	Perutpapan / keras
G74	Stomach board / hard
G75	No seizures
G76	There is no respiration disorder
G77	Trismus (difficulty opening mouth) moderate
G78	The presence of excitatory seizures, no spontaneous seizures
G79	Mild dysphagia
G80	Trismus (difficulty opening the mouth) is severe
G81	Spastic muscles
G82	spontaneous seizures
G83	Tachycardia (DJB> 160x / minute)
G84	Apneu attack
G85	Severe dysphagia
G86	Autonomous system activity increases
G87	Gong face
G88	Tilted eyes
G89	Labiokizis
G90	Palatoskizis
G91	Labiopalatoskizis
G92	Gnatoskizis
G93	There is no anal canal (atresia ani)
G94	Polydactyl
G95	Sindaktili
G96	Polysindactyl
G97	Yellow skin
G98	High-pitched tears
G99	Takipneu (breath> 60x / minute)

Disease tables are used to determine diseases suffered by newborns. Disease determination is based on symptom data in new cases that are matched with symptom data in old cases that show the highest similarity. Disease data displayed in the consultation are data of disease that has the highest similarity value. , calculated based on the Sorgenfrei algorithm. In the disease table, there is code data that shows the sequence of disease codes, and newborn disease names can be seen in Table 3.

TABLE III
DISEASE NAME

Disease Code	Disease Name
P01	Troubled Newborns / with Complications
P02	Physiological jaundice
P03	Pathological jaundice
P04	Kern Ikterus
P05	Constipation
P06	Acute diarrhea
P07	Chronic diarrhea
P08	Cough and cold
P09	Sepsis Neonatorum
P10	Umbilical Cord Bleeding
P11	Pneumonia
P12	Mild Tetanus
P13	Medium Tetanus
P14	Heavy Tetanus
P15	Congenital Abnormalities

III. RESULT AND DISCUSSION

A. Results

The results of the research from the expert system with the Sorgenfrei method for diagnosing of newborn diseases can be seen in Table 4.

TABLE IV
TEST RESULT

Selected Symptoms	Emerging diseases	Similarity Percentage
1. Defecate more than 4 times per day. 2. Unconscious. 3. Concave Eyes 4. Restless or Fussy 5. Movement is less active (Hypotonic Muscle). 6. Edema Extremities (Swelling).	Acute diarrhea	*similaritas* 0,5333 or 53,33%
	Newborns have problems or complications	*similaritas*0,0476 or 4,76%
	Cough and cold	*similaritas*0,0417 or 4,17%

B. Discussion

The expert system uses the sorgenfrei method to diagnose newborns calculated by sorgenfrei, referred to in equation (2).

$$.S = \frac{a^2}{(a+b)(a+c)} \qquad (2)$$

S = Value Similarity
a = The same number of attributes between consultation and data stored in the database.
b = The amount of data stored in the database, which is not in the consultation.
c = Number of consulting data attributes, which are not stored in the database.
Then the consultation is carried out by selecting the symptoms of newborn diseases, namely:

1. Chapter more than 4 times per day.
2. Unconscious.
3. Concave Eyes
4. Restless or Fussy

5. Movement is less active (Hypotonic Muscle).
6. Edema Extremities (Swelling).

The results of the expert system consultation with Sorgenfrein's similarity to diagnose newborn diseases are:

1. Calculation of acute diarrheal disease

New case	Acute diarrhea
The symptoms: 1. defecate more than 4 times per day. 2. Unconscious. 3. Concave eyes. 4. Restless or fussy. 5. Movement is less active (Hypotonic Muscle). 6. Edema Extremities (swelling)	The symptoms: 1. Defecate more than 4 times per day.. 2. Unconscious. 3. Concave eyes 4. Restless or fussy. 5. Skin Not elastic.

Based on calculations with Sorgenfrein's similarity, acute diarrhea has a value indicated in equation (3).

$$S = \frac{a^2}{(a+b)(a+c)} \qquad (3)$$

a = 4, b = 2, c = 1
so the similarity value S = 0.5333 x 100% = 53.33%.

2. Calculation of newborn problems with problems or complications

New case	Newborns have problems or complications
Symptoms: 1. Defecate more than 4 times per day. 2. Unconscious. 3. Sunken eyes. 4. Restless or fussy. 5. Inactivity (Hypotonic Muscle). 6. Edema Extremities(swelling)	Symptoms: 1. Body weight at birth lbw = 1500 - 2499 grams 2. Body length <45 cm 3. Inactive movements (hypotonic muscles) 4. Head circumference <32 cm 5. Edema Extremities (swelling) 6. Chest circumference <30 cm 7. Head bigger than body, thin and fine hair 8. Soft skull bones 9. Simple-shaped ears and little cartilage 10. small or not formed nipples 11. breathing <20x / minute 12. Thin skin, transparent, lanugo (fine hair), especially on the forehead, forehead temples and arms, blood vessels visible. 13. Genetalia is not perfect, in women the labia minor has not been covered by labia majora, the clitoris protrudes. In small scrotal LK men, the testes are not palpable 14. Reflexes suck, swallow and cough weakly,

Based on calculations with Sorgenfrein's similarity, newborns with problems or complications have a value indicated in equation (4):

$$S = \frac{a^2}{(a+b)(a+c)} \qquad (4)$$

a = 2, b = 4, c = 12
so the similarity value S = 0,0476 x 100% = 4,76%

7. Calculation of cold cough disease

Kasusbaru	DiareAkut
Symptoms: 1. Chapter more than 4 times per day. 2. Unconscious. 3. Sunken eyes. 4. Restless or fussy. 5. Inactivity (Hypotonic Muscle). 6. Edema Extremities (swelling)	Symptoms: 1. Restless or fussy 2. Cough 3. Sometimes it contains 4. Secret out of the nose (runny nose)

Based on calculations with Sorgenfrein's similarity, cold cough has a value indicated in equation (5).

$$S = \frac{a^2}{(a+b)(a+c)} \qquad (5)$$

a = 1, b = 5, c = 3
so the similarity value S = 0,0417 x 100% = 4,17%

IV. CONCLUSION

The results of the research that the researchers have described in the previous chapters, the Sorgenfrei similarity method for diagnosing newborn diseases can be summarized as follows:

1. The Sorgenfrei similarity method can be used to find diagnoses of newborn diseases to users.
2. Sorgenfrei similarity produces a final value of similarity between 0 zero and 1 one.
3. Consultation results that show a percentage below 20% will be accommodated in the revised table to find the most appropriate solution.

4. The highest value of the research trial from the random selection of symptoms gets a percentage of 53.33%.

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