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Expert System for Diagnosis of Tifoid Disease Using Dempster Shafer Method

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Abstract:
An expert system in general is a system that seeks to adopt human knowledge into computers so that computers can solve problems as is usually done by experts, or in other words, an expert system is a system designed and implemented with the help of a particular programming language to be able to solve problems as experts do. It is hoped that with this system even ordinary people can solve certain problems, both "a little" complicated even "without" the help of experts in the field. As for the experts, this system can be used as an experienced assistant. Typhus or typhoid fever is an acute infection of the small intestine caused by the bacterium Salmonella typhi. In this final project, a system is designed to diagnose typhoid. The lack of sensitivity to the symptoms of diseases that are often experienced by the community and the lack of availability of medical personnel at the Benjamin Guluh Kolaka Hospital requires a system that can diagnose typhoid. The system is designed based on an expert system for the diagnosis of typhoid using the Dempster Shafer method.The time needed to prepare this research is approximately 3 (three) months, starting in October-December 2021. The researcher conducts research at Benyamin Guluh Kolaka Hospital, Kolaka District, Kolaka Regency, Southeast Sulawesi.In developing the system the researcher uses the Waterfall model. The inside of the expert system consists of 2 main components, namely the knowledge base which contains the knowledge base and the inference engine that describes the knowledge.

***Key Word**: Typhoid Desease; Dempster Shafer; Expert System*

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I. Introduction

Typhoid or typhoid fever is an acute infection of the small intestine caused by the bacterium *Salmonella typhi*. Typhoid fever is characterized by prolonged heat followed by bacteremia and invasion of *Salmonella typhi bacteria* as well as multiplication into mononuclear phagocytic cells from the liver, spleen, intestinal lymph nodes and *Peyer's patches* (Abdoerrachman, 2008). Typhoid fever can also be transmitted from people who are exposed to typhoid fever and food infected by the bacterium *Salmonella typhi*.

WHO (*World Health Organization*) estimates that there are about 17 million deaths occur each year due to this disease. Asia ranks highest in this *typhoid case*, and 13 million cases are occurring each year. In Indonesia, it is estimated that between 800-100,000 people are affected by typhoid fever throughout the year. Typhoid cases are suffered by 91% of children aged 3-19 years with a mortality rate of 20,000 per year. In developing countries, *Salmonella typhi* is transmitted through food and water that has poor sanitation such as in roadside stalls and infects various foodstuffs such as water, ice cubes, raw vegetables and fruits. Whereas in developed countries, typhoid fever is obtained as a result of being transmitted by *travelers* who have traveled from endemic areas with typhoid fever (Rahayu, 2013). In Indonesia, this disease is endemic and is a public health problem, one of which is at the Benjamin Guluh Kolaka Hospital.

The availability of medical personnel or doctors is also still relatively minimal at the Benyamin Guluh Kolaka Hospital. So it makes many people find it difficult to diagnose typhoid early so medical treatment becomes too late and even fatal for the patient. So it is very necessary to create a system that can diagnose diseases such as experts or experts. So we need a system that can diagnose typhoid.

An expert system is a computer program that contains knowledge from one or more human experts regarding a specific field (Kusumadewi, 2003). The method used to support the diagnosis is the *Dempster Shafer method*. There are two important things in the *Dempster Shafer method*, namely *belief function* and *plausible reasoning*. Both of these are used to combine separate pieces of information (evidence) to calculate the probability of an event. The *Dempster Shafer theory* is based on two ideas, namely the idea of obtaining a degree of confidence from various subjective possibilities and the *Dempster Shafer rule* itself to combine the degree of confidence based on the evidence obtained. The *Dempster Shafer method* is used because it has advantages such as being able to combine *evidence* from several sources, being able to distinguish between uncertainty and ignorance, having characteristics according to the way an expert thinks, very suitable for use in expert systems that measure something uncertain or not.

Previously, the *Dempster Shafer method* had been used by previous researchers, namely (Sinaga & Sembiring, 2016) which in their research applied the *Dempster Shafer method* to diagnose diseases caused by *Salmonella bacteria.* The *Dempster Shafer method* has been successfully applied to diagnose diseases caused by *Salmonella bacteria*. Therefore, the researcher will create an expert system using the *Dempster Shafer method, which* is expected to be able to diagnose typhoid and be able to provide information to the public about the disease, symptoms of an attack and how to prevent it.

II. Materials And Methods

Research schedule

The time needed to prepare this research is approximately 3 (three) months, starting in October-December 2021. The researcher conducts research at Benyamin Guluh Kolaka Hospital, Kolaka District, Kolaka Regency, Southeast Sulawesi.

System Development Method

In developing the system the researcher uses the *Waterfall* model with the following stages:

1) System requirements analysis
   The stage where the researcher determines the needs of the system to be made in this case an expert system for diagnosing typhoid disease using the *Dempster-Shafer method.*
2) System design
   In this stage the researcher makes a system design using several tools to describe the current system or new system. The tools and materials that will be used by the researcher in designing the system are system design using table structures, DFD (*Data Flow Diagrams*), and process design flowcharts in the system flow design function to describe in general what the system will be made.
3) Coding
   At this coding stage, the researcher uses the PHP programming language.
4) System testing
   At this stage, the program that has been made is tested per unit and then put together into a complete system and tested as a whole to test the level of integration between the previously created units. Where the functions of the *software* are tested so that the *software is* free from *errors* and the results must meet the needs. The test used in this study is *Black Box testing.* Where this test also includes manual calculations and system calculations that are useful for testing the system whether it is correct and can be used or not. System testing is carried out to determine the level of system accuracy using system accuracy testing to find out the final results or *outputs* in the form of possible types of diseases produced by the expert system and those produced by experts.
5) Implementation
   The implementation stage is the longest in the *waterfall cycle phase* (life cycle). The system is installed and put into simple use. Maintenance involves correcting errors that were not found in the early stages of the *waterfall cycle*, improving the implementation of system units and improving system serviceability as new requirements are discovered.

Data collection technique

1) Observation
   The researcher made direct observations with related parties to find data and information related to typhoid disease.
2) Study of literature
   The researcher searches for reference data related to research through literature, journals, books, articles and *online references.*
3) Interview
   The types of data used in this research are primary data and secondary data. Primary data is data obtained through the interview method. Secondary data is data obtained from literature studies. The data and information collection carried out included disease criteria, symptoms, belief values, and treatment.

System Design

The processing design that will be carried out in the application of the *Dempster-Shafer method* is: first the *User* will input data on symptoms of the disease, and then the system will condition the symptoms if the symptoms experienced are not by what the system displays, the *User* can choose *no*, then the *User* will re-enter the other symptoms. However, if the symptoms experienced are those displayed by the system, the *user* can choose *yes*, to select the symptoms then the system will perform *Dempster-Shafer reasoning* from the symptoms that have been inputted then the system will automatically display a diagnosis of the disease from the symptoms of the attack experienced and how to prevent it.

The process of an expert system for diagnosing typhoid using the *dempster-shafer method, the user* first inputs the symptoms and selects the symptoms experienced by the patient for *dempster-shafer calculations* then the system will display the results of the diagnosis of *typhoid.*

Needs Analysis

Some of the hardwareused are; Acer Aspire 3 Laptops and 2700 . IP Printer. Some of the software used are; 1) Sublime Text, 2) Xampp, and 3) Google Chrome

III. Result

System Analysis

In this research, a system analysis was carried out to apply an expert system to diagnose typhoid using the WEB-Based *Dempster Shafer method.* Software analysis is a step in understanding the problem before taking an action or decision to resolve the main result. The availability of medical personnel or doctors is also still relatively minimal at the Benyamin Guluh Kolaka Hospital. So with this, many people find it difficult to diagnose typhoid early so medical treatment becomes too late and even fatal for the patient. So it is very necessary to create a system that can diagnose diseases such as experts or experts. So we need a system that can diagnose typhoid.

An expert system is a computer-based information system that uses expert knowledge to achieve high-*level* decision performance in a narrow problem domain. The inside of the expert system consists of 2 main components, namely the *knowledge base* which contains the knowledge base and the *inference engine* that describes the knowledge. The method used to support the diagnosis is the *Dempster Shafer method*. There are two important things in the *Dempster Shafer method*, namely *belief function* and *plausible reasoning*. These two are used to combine separate pieces of information (evidence) to calculate the probability of an event

System analysis in this study aims to formulate a problem that occurs and identify the expected system requirements so that improvements can be proposed and ensure that the system analysis has been running on the right track.

Running System

In the running system, the staff receives patient complaint data and diagnoses the patient's typhoid disease. After being diagnosed, the staff will make a diagnosis report so that it becomes a diagnosis report and is given to the patient.

Proposed System

In the proposed system, the user or admin (nurse) inputs disease data, symptoms, rules, and patients along with the symptoms they experience into an expert system to diagnose typhoid using the *Dempster Shafer method* and generate reports of diagnostic results that can be provided to patients.

***Shafer's Dempster* Method**

The types of typhoid fever (typhoid) are as follows:

Table 1 Disease Table

Disease Code	Disease
P01	Typhoid Epidemic
P02	Endemic Typhoid
P03	Typhoid Scrub

Table 1 is the type of typhoid fever (typhoid) that the researchers studied in the form of epidemic typhus, endemic typhus and scrub typhus.

The symptoms of typhoid are fever and chills, headache, rapid breathing, muscle and body pain, rash, cough, nausea and vomiting, confusion, back and joint pain, dry cough, stomach pain, and dark area at the bite site. mites like scabs, Mental changes occur, and enlarged lymph nodes.

IV. Discussion

System planning

a. Context Diagram

In the context diagram, the admin can *input* data on symptoms, diseases, rules, and patient symptom data into the system. So that the system generates a report on the results of the diagnosis that can be given to the patient.

b. Diagram of Level 0

In the diagram of level 0, the admin can *input* data on symptoms, diseases and rules, each of which will be stored in the tb_disease, tb_symptoms and tb_rule tables. Admin and patients can also carry out the diagnosis process by entering patient symptom data and the data will be stored in the tb_diagnosis table. Then the system can generate diagnostic results that can be given to the plant owner.

c. Diagram of Level 1 Process 1

In the diagram of level 1 process 1, the admin can *input* data on symptoms, diseases and rules, each of which will be stored in the tb_disease, tb_symptoms and tb_rule tables.

d. Diagram of Level 1 Process 2

In the diagram of level 1 process 2, the admin and patient can *input* patient symptom data so that the system will produce the results of the diagnosis which will be stored in the tb_diagnosis table.

e. Diagram of Level 1 Process 3

In the diagram of level 1 process 3, the system will produce diagnostic results that can be seen by plant owners and admins can view information on symptoms and diseases.

Database Design

1. Table Structure

The database tables contained in the expert system for diagnosing typhoid disease using the *Dempster Shafer method* are as follows:

a. Disease Data Storage Table
Table Name: tb_disease
Primary Key: id_disease
Description: Filled with disease data
Disease data storage table is a table that serves as a place to store disease data. member disease consists of id_disease and name_disease. The primary key of the disease table isid_disease.

b. Symptom Data Storage Table
Table Name: tb_symptoms
Primary Key: id_symptoms
Description: Filled with symptom data
The symptom data storage table is a table that functions as a data storage place for symptom data. The symptom table consists of symptom_id and symptom_name. The primary key of the symptom table is id_symptom.

c. Rules Data Storage Table
Table Name: tb_rule
Primary Key: id_rule
Description: Filled with data rules
The rule data storage table is a table that serves as a place to store rule data data. The rule table consists of id_rule, id_symptom, id_disease and probability. The primary key of the rules table is id_rule.

d. Diagnostic Data Storage Table
Table Name: tb_diagnosis
Primary Key: id_ diagnosis
Description: Filled with diagnostic data
A diagnostic data storage table is a table that serves as a place to store diagnostic data. The diagnosis table consists of diagnosis_id, owner_name, diagnosis_date, disease_id and value. The primary key of the diagnosis table is id_diagnosis.

e. *User* Data Storage Table
Table Name: tb_ *user*
Primary Key: id_ *user*
Description: Filled with admin data
User data storage table is a table that serves as a place to store admin data. The *user* table consists of id_ *user* , *user* and pass. The primary key of the *user table* is id_ *user* .

2 Relationships Between Tables

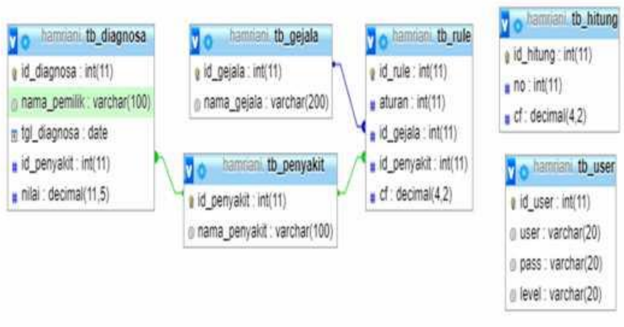

Figure 1 Relationships Between Tables

In Figure 1 there are four interrelated tables, namely tb_rule which is related to tb_symptoms and tb_disease and the last is tb_disease which is related to the tb_diagnosis table.

Flowchart

A flowchart is a scheme that describes the sequence of activities of a program from start to finish. Some of the *flowcharts* used are as follows:

1 *Flowchart* Login

In the login *flowchart*, the admin *inputs the user* name and password, if the admin presses the login button then the system will *validate* the *user* name and password, if correct then the system goes to the main menu page and if wrong , the system will display the message "sorry login failed" .

2 Main Menu *Flowchart*

In the admin main menu *flowchart*, there are five main menus, namely the homepage which will display the home page, the database menu which will display disease, symptom and rule submenu, and the consultation menu which when clicked will display the consultation page, the *output menu* which if clicked it will display a diagnosis report submenu and a logout menu which if clicked will return to the login page.

3 Disease *Input Form Flowchart*

In the disease *input form flowchart* , if the admin presses add data then the system will display the *form* add disease data and the admin *inputs* data by pressing the submit data button and the system will save the data, if the admin presses *edit* data then the system will display the disease data *edit form* and admin *input* data by pressing the *update* data button and the data will be *updated* and if you press delete then the system will delete data based on the deleted id.

4 *Flowchart of* Symptom Input Form

In the symptom *input form flowchart* , if the admin presses add data then the system will display the add symptom data *form* and the admin *inputs* data by pressing the submit data button and the system will save the data, if the admin presses *edit* data then the system will display the symptom data *edit form* and admin *input* data by pressing the *update* data button and the data will be *updated* and if you press delete then the system will delete data based on the deleted id.

5. *Flowchart Input* Rule

In the *flowchart of the input* rule form, if the admin presses add data, the system will display the add data rule *form* and the admin *inputs* data by pressing the submit data button and the system will save the data, and if you press delete, the system will delete the data based on the id you entered. deleted.

6. Diagnostic *Flowchart*

In the admin diagnosis *flowchart* first *inputs* the patient's symptom data, then the system will perform the calculation process and produce a diagnosis of the disease experienced by the patient.

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System Implementation

1. Login Page

Figure 2 Login Page

In Figure 2, the admin login page needs to *input the user* name and password, after that press the login button and the system will check the *user* name and password in the *database* . If the *user* name and password are in *the database* , the system will display the main page and if they are not in *the database* , the system will display an incorrect *user* name and password message.

```
$sql = mysql_query("SELECT * from tb_user where user = '$user' and pass =
'$pass'") or die(mysql_error());
      $data = mysql_fetch_array($sql);
      $cek = mysql_num_rows($sql);
      if($cek > 0){
        if ($data['level'] == 'admin') {
          $_SESSION['admin'] = $data['id_user'];
          $_SESSION['time'] = time()+(200*60);
          header("location: index.php");
        } else {
          $_SESSION['kepala'] = $data['id_user'];
          $_SESSION['time'] = time()+(200*60);
          header("location: ../kepala/index.php");
        }
      }else{
       ?><script type="text/javascript">
                    alert('Username Atau Password Salah');
                    window.history.go(-1);
              </script><?php
      }
```

2. Admin Main Menu Page

Figure 3 Admin Main Menu Page

In Figure 3 the main menu page contains six main menus, namely the homepage which when clicked will display the home page, the *input menu* which will display disease, the symptom and rule submenus, the diagnosis menu which will display the diagnosis page, the *output menu* which will display a submenu of the diagnosis report, the *user* , which will display the *user page* and the logout menu, which will return to the login page.

```
if($page == "penyakit"){
        if($aksi == ""){
            include 'penyakit/index.php';
        }else if($aksi == 'edit'){
            include 'penyakit/edit.php';
        }else if($aksi == 'hapus'){
            include 'penyakit/hapus.php';
        }else if($aksi == 'tambah'){
            include 'penyakit/tambah.php';
        }
    }else if($page == "gejala"){
        if($aksi == ""){
            include 'gejala/index.php';
        }else if($aksi == 'edit'){
            include 'gejala/edit.php';
        }else if($aksi == 'hapus'){
            include 'gejala/hapus.php';
        }else if($aksi == 'tambah'){
            include 'gejala/tambah.php';
        }
    }}else if($page == "rule"){
        if($aksi == ""){
            include 'rule/index.php';
        }else if($aksi == 'edit'){
            include 'rule/edit.php';
        }else if($aksi == 'hapus'){
            include 'rule/hapus.php';
        }else if($aksi == 'tambah'){
            include 'rule/tambah.php';
```

3. Disease *Input Page*


Data Penyakit

No	Kode Penyakit	Nama Penyakit	Ubah	Hapus
1	P01	Epidemic Typhus	Edit	Hapus
2	P02	Endemik Tifus	Edit	Hapus
3	P03	Scrub Typhus	Edit	Hapus

Tambah

Figure 4 Disease *Input Page*

In Figure 4, the disease *input page* , if the admin presses add data then the system will display the *form* add disease data and the admin *inputs* data by pressing the submit data button and the system will save the data, if the admin presses *edit* data then the system will display the disease data *edit form and the* admin *inputs* data by pressing the data *update button* and the data will be *updated* and if you press delete then the system will delete data based on the deleted id

```
<?php
$no = 1;
$sql = mysql_query("SELECT * from tb_penyakit");
while ($tampil = mysql_fetch_array($sql)){
?>
<tr>
<td><?php echo $no++ ?></td>
<td><?php echo $tampil['nama_penyakit']; ?></td>
<td align="center">
<a href="?page=penyakit&aksi=edit&id=<?php echo $tampil['id_penyakit'];
?>" class="btn btn-warning btn-xs">Edit</a>
<a href="?page=penyakit&aksi=hapus&id=<?php echo
$tampil['id_penyakit']; ?>" class="btn btn-danger btn-xs">Hapus</a>
</td><?php }?>
```

4. Symptom *Input* Page


Data Gejala

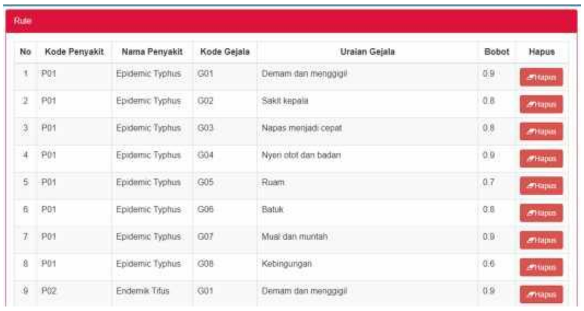
No	Kode Gejala	Gejala	Bobot	Ubah	Hapus
1	G01	Demam dan menggigil	0.9	Edit	Hapus
2	G02	Sakit kepala	0.8	Edit	Hapus
3	G03	Napas menjadi cepat	0.8	Edit	Hapus
4	G04	Nyeri otot dan badan	0.9	Edit	Hapus
5	G05	Ruam	0.7	Edit	Hapus
6	G06	Batuk	0.8	Edit	Hapus
7	G07	Mual dan muntah	0.9	Edit	Hapus
8	G08	Kebingungan	0.6	Edit	Hapus
9	G09	Nyeri Punggung dan Persendian	0.8	Edit	Hapus

Figure 5 Symptom *Input Page*

In Figure 5 the symptom *input page*, if the admin presses add data then the system will display the *form* add symptom data and the admin *inputs* data by pressing the submit data button and the system will save the data, if the admin presses *edit* data then the system will display the symptom data *edit form and the* admin *inputs* data by pressing the data *update button* and the data will be *updated* and if you press delete then the system will delete data based on the deleted id

```
<?php
$no = 1;
$sql = mysql_query("SELECT * from tb_gejala");
while ($tampil = mysql_fetch_array($sql)){
?>
<tr>
<td><?php echo $no++ ?></td>
<td><?php echo $tampil['nama_gejala]; ?></td>
<td align="center">
<a href="?page=gejala&aksi=edit&id=<?php echo $tampil['id_ gejala ']; ?>"
class="btn btn-warning btn-xs">Edit</a>
<a href="?page=penyakit&aksi=hapus&id=<?php echo $tampil['id_ gejala'];
?>" class="btn btn-danger btn-xs">Hapus</a>
</td><?php }?>
```

5. *Input* Rule Page



No	Kode Penyakit	Nama Penyakit	Kode Gejala	Uraian Gejala	Bobot	Hapus
1	P01	Epidemic Typhus	G01	Demam dan menggigil	0.9	Hapus
2	P01	Epidemic Typhus	G02	Sakit kepala	0.8	Hapus
3	P01	Epidemic Typhus	G03	Napas menjadi cepat	0.8	Hapus
4	P01	Epidemic Typhus	G04	Nyeri otot dan badan	0.9	Hapus
5	P01	Epidemic Typhus	G05	Ruam	0.7	Hapus
6	P01	Epidemic Typhus	G06	Batuk	0.8	Hapus
7	P01	Epidemic Typhus	G07	Mual dan muntah	0.9	Hapus
8	P01	Epidemic Typhus	G08	Kebingungan	0.6	Hapus
9	P02	Endemik Tifus	G01	Demam dan menggigil	0.9	Hapus

Figure 6 Page *Input* Rule

In Figure 6 the *input* rule page, if the admin presses add data, the system will display the add data rule *form* and the admin *inputs* data by pressing the submit data button and the system will save the data and if you press delete, the system will delete the data based on the deleted id.

```
<?php
$no = 1;
$sql = mysql_query("SELECT * from tb_rule inner join tb_penyakit on
tb_rule.id_penyakit = tb_penyakit.id_penyakit inner join tb_gejala on
tb_rule.id_gejala = tb_gejala.id_gejala order by tb_penyakit.id_penyakit,
tb_gejala.id_gejala ");
<td><?php echo $no++ ?></td>
<td><?php echo $tampil['nama_penyakit']; ?></td>
<td><?php echo "G".$tampil['id_gejala']; ?> <?php echo
$tampil['nama_gejala']; ?></td>
<td><?php echo $tampil['probabilitas']; ?></td>
<td align="center">
<a href="?page=rule&aksi=edit&id=<?php echo $tampil['id_rule']; ?>"
class="btn btn-warning btn-xs">Edit</a>
<a href="?page=rule&aksi=hapus&id=<?php echo $tampil['id_rule']; ?>"
class="btn btn-danger btn-xs">Hapus</a>
</td>
```

6. Diagnosis page

Figure 7 Diagnosis Page

In Figure 7 on the diagnosis page, the admin first inputs patient data and symptoms experienced by the patient, then the system will perform the calculation process and produce a diagnosis of the disease experienced by the patient.

```
<?php
$ $densitas_baru=array();
      while(!empty($gejala)){
         $densitas1[0]=array_shift($gejala);
         $densitas1[1]=array($fod,1-$densitas1[0][1]);
         $densitas2=array();
         if(empty($densitas_baru)){
            $densitas2[0]=array_shift($gejala);
         }else{
            foreach($densitas_baru as $k=>$r){
               if($k!="&theta;"){
                  $densitas2[]=array($k,$r);
               }
            }
         }
         $theta=1;
         foreach($densitas2 as $d) $theta-=$d[1];
         $densitas2[]=array($fod,$theta);
         $m=count($densitas2);
         $i=$m-1;
         echo "<br/>Kombinasi ".$m."<br/>";
         echo "-----------------------------------------------------------<br>";
```

```
         $densitas_baru=array();
                        for($y=0;$y<$m;$y++){
            for($x=0;$x<2;$x++){
               if(!($y==$m-1 && $x==1)){
                  $v=explode(',',$densitas1[$x][0]);
                  $w=explode(',',$densitas2[$y][0]);
                  sort($v);
                  sort($w);
                  $vw=array_intersect($v,$w);
                  if(empty($vw)){
                     $k="&theta;";
                  }else{
                     $k=implode(',',$vw);
                  }
                  if(!isset($densitas_baru[$k])){
$densitas_baru[$k]=$densitas1[$x][1]*$densitas2[$y][1];
                  }else{
$densitas_baru[$k]+=$densitas1[$x][1]*$densitas2[$y][1];
                  }
               }
            }
         }
         foreach($densitas_baru as $k=>$d){
            if($k!="&theta;"){
               $densitas_baru[$k]=$d/(1-
(isset($densitas_baru["&theta;"])?$densitas_baru["&theta;"]:0));
            }
            echo "m".$m." ".$k."=".$densitas_baru[$k]." <br/>";
         }
        // print_r($densitas_baru);
      }
      ?>
```

7. Sample Report

Data Hasil Diagnosa

No	Nama Pasoen	Hasil Diagnosa	Persentase
1	Sebastian Haler	Epidemic Typhus	98.00 %
2	Mahfud MD	Scrub Typhus	92.42 %
3	Sukma	Epidemic Typhus,Endemik Tifus,Scrub Typhus	98.00 %
4	Saya	Epidemic Typhus	44.44 %
5	Sri Mulyani	Epidemic Typhus	80.00 %

Figure 8 Diagnostic Results Report

In Figure 8 the diagnosis report is an *output* of an expert system for diagnosing typhoid disease using the *Dempster Shafer method* which contains diagnostic data that has been carried out by the admin.

System Test

The following is a case for testing software built using the *Black Box method*. This test attempts to find errors in the categories of incorrect or missing functions, *interface errors*, errors in data structures or external database access, performance errors, and initialization and terminal errors.

1 . System Testing on the Login Page

In the system teston the admin login page, the researcher performs a test scenario by emptying one of the textboxes and pressing the login button, and from the researcher's observations the system has run as (*valid*) as expected. The researcher also conducted a test scenario by *inputting the appropriate user* name and password in the database, and from the researcher's observations, the system was running as (*valid*) as expected.

2 . System Testing on the Admin Main Page

In the system test on the admin main menu page, the researcher performs a test scenario by clicking the dashboard menu, and from the researcher's observation the system has run as (*valid*) as expected. The researcher also carried out a test scenario by clicking the logout menu, and from the researcher's observation, the system was running as (*valid*) as expected .

3 System Testing on the Disease Data Page

In the system test on the disease data page, the researcher performs a test scenario by clicking the add button, and from the researcher's observations the system has run as (*valid*) as expected. The researcher also conducted a test scenario by clicking the delete button, and from the researcher's observations, the system was running as (*validly*) as expected.

4 System Testing on Symptom Data Pages

In the system test on the symptom data page, the researcher performs a test scenario by clicking the add button, and from the researcher's observations the system has run as (*valid*) as expected. The researcher also conducted a test scenario by clicking the delete button , and from the researcher's observations, the system was running as (*validly*) as expected.

5 System Testing on the Rule Data Page

In the system test on the rule data page, the researcher performs a test scenario by clicking the add button, and from the observations of the researcher, the system has run as (*valid*) as expected. The researcher also conducted a test scenario by clicking the delete button, and from the researcher's observations, the system was running as (*validly*) as expected.

System Accuracy Test

System accuracy testing is done to determine the accuracy of a system. Testing the accuracy of this system is done using *a confusion matrix* . Based on 10 data from the results of the diagnosis using the *Dempster Shafer method* with the results of the diagnosis carried out by experts, 8 data that match the expert results with the results of the *Dempster Shafer* system and 2 data results using the *Dempster Shafer method* that is not by the expert results.

$$x = \frac{ji \quad hd \quad y \quad s}{ji \quad hd} X100\ \%$$

$$x = \frac{8}{10} X100\ \% = 80\%$$

Is known :
x : *variable* adjustment of expert results with the results of *Dempster Shafer*

Name	*Dempster Shafer* result	*Expert* result	note
Siti Raehana	*Epidemic Typhoid*	*Epidemic Typhoid*	match
Suci Fitria	*Epidemic Typhoid*	*Epidemic Typhoid*	match
Gita	*Scrub Typhus*	*Scrub Typhus*	match
Ardi	*Endemic Typhoid*	*Endemic Typhoid*	match
Rezky	*Scrub Typhus*	*Endemic Typhoid*	did not match
Kiano	*Endemic Typhoid*	*Endemic Typhoid*	match
Kahar	*Scrub Typhus*	*Scrub Typhus*	match
Nurhaeda	*Scrub Typhus*	*Scrub Typhus*	match
Siti Susanti	*Endemic Typhoid*	*Endemic Typhoid*	match
Nasir	*Endemic Typhoid*	*Scrub Typhus*	did not match

Table 2 Results of Appropriate and Incompatible System Testing Data

In table 2, the appropriate and inappropriate system testing, the researchers conducted tests to determine the accuracy of the *Dempster Shafer method expert system* with the results of the diagnosis carried out by experts and from the tests carried out by the researchers that two data that did not match, namely the results of the Rezky and Nasir diagnose. According to the results of *Dempster Shafer* Rezky, he was diagnosed with *Scrub Typhus*, while according to the expert, Rezky was diagnosed with *Endemic Typhoid* and *Dempster Shafer* Nasir was diagnosed with *Epidemic Typhoid* , while according to the expert, Nasir was diagnosed with *Scrub Typhus*. So from 10 data there are 8 data that match the expert results with the results of *Dempster Shafer* with an accuracy rate of 80%.

V. Conclusion

Based on the discussion in the previous chapters, the researcher can conclude several things by using an expert system to diagnose typhoid disease using the *Dempster Shafer method* as follows:

1. By using an expert system to diagnose typhoid disease using the *Dempster Shafer method*, it can diagnose typhoid in patients with 80% accuracy testing.
2. Based on the results of *black box testing*, it can be concluded that the expert system for diagnosing typhoid using the *Dempster Shafer method is* free from program errors.

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