Application of the Forward Chaining Method in Diagnosing Tomato Fever

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Abstract

Health is a factor that always needs to be taken care of by each personal. Some things you can do to stay healthy are eating nutritious foods, exercising, taking care of the environment, etc. However, a person can experience health problems due to communicable diseases and non-communicable diseases. A communicable disease is a disease that can be transmitted from one person to another, directly or indirectly. One of the infectious diseases discussed some time ago in India was tomato flu. Tomato flu is an illness that results from a red rash and blisters that look like tomatoes caused by the flu. This disease is contagious in children under five years old. Tomato flu has some symptoms that are common with other infectious diseases, so people can be infected with other infectious diseases. The role of experts is necessary, but the number of experts cannot be compared with the number of victims. Therefore, an expert system is needed to diagnose these infectious diseases by the method of Forward Chaining. This method was chosen because it can diagnose infectious diseases based on a set of established data. Expert system testing is done using Black Box Testing, where each tested item generates a successful state.

Keywords: Expert System, Forward Chaining, Tomato Fever, Infectious Disease, Diagnosis

1.0 INTRODUCTION

Health is a factor that every human being must always pay attention to. According to the World Health Organization (WHO), health is a state of physical, mental and social well-being that makes it possible for every human being to live a socially and economically productive life (Rai Widyasari, 2020). Several things you can do to stay healthy include consuming nutritious food, maintaining cleanliness both yourself and the environment, and so on. However, this does not guarantee that every human being will always live a healthy life.

A number of diseases have been discovered and researched by experts, both infectious and non-communicable diseases. One of the infectious diseases that was discussed some time ago was Tomato Flu. Tomato Flu is a disease caused by flu where the flu causes a red rash and blisters accompanied by irritation of the skin and is similar to the appearance of a tomato. This disease is characterized by several symptoms on the body, including red rashes, fatigue, blistered skin, fever, and so on.

However, the symptoms caused by Tomato Flu have some similarities with other infectious diseases. So the role of an expert or specialist is needed to be able to know exactly what infectious disease the patient is suffering from. However, the number of experts or specialist is not comparable to the number of sufferers of this infectious disease. Thus experts or specialist cannot consult directly with all patients who have similar symptoms. Therefore, an expert system is needed that can help experts or experts to diagnose someone based on the symptoms that arise.

An expert system is a system that attempts to apply human abilities or knowledge to a computer, so that the computer can work in solving problems like an expert (Setyaputri et al., 2018). One method that can be implemented into an expert system is the Forward Chaining method. Forward Chaining is a method that uses or applies a set of action-condition rules (Nora Marlim and Joni Kurniawan, 2018). There are several conditions where a system can apply the forward chaining method, namely each system looks for rules in the knowledge base to correspond to conditions in the IF section, then each rule can produce a new condition from the conclusion requested in the THEN section, and each new condition will be added to other existing conditions (Nengsih and

Putra, 2020). So the forward chaining method can be applied in diagnosing Tomato Flu, and it is hoped that it can help the public in diagnosing this infectious disease without having to see an expert.

2.0 LITERATURE REVIEW

Health
According to WHO (World Health Organization), health is a state of physical, mental and social well-being that makes it possible for every individual to live a socially and economically productive life (Rai Widyasari, 2020).

Disease
According to Sapta Permana and Sumaryana (2018), disease is a failure of an organism's adaptation mechanisms to react appropriately to stimulation or pressure, leading to disruption of the function, structure of organs or body systems. Meanwhile, according to Andreswari et al., (2023), disease can be defined as a condition where there is a disturbance in the form or function of one part of the body which causes the body to be unable to work or carry out normal activities. There are several infectious diseases related to research, including:

1. Tomato Fever
   Tomato Fever (Tomato Flu) is a disease caused by flu where the flu causes a red rash and blisters accompanied by irritation of the skin and is similar to the appearance of a tomato. This infectious disease has been infecting a number of toddlers aged less than five years in India recently. Tomato Flu is characterized by several symptoms on the body, including red rashes, fatigue, blistered skin, fever, and so on.

2. Covid-19
   Covid-19 is an infectious disease caused by a new type of corona virus that emerged at the end of 2019 in Wuhan, China which caused a pandemic throughout the world. The main symptoms of Covid-19 are cough, fever and difficulty breathing. The way this disease is spread through coughing or sneezing from an infected person. Apart from coughing and sneezing, this disease can also be transmitted through objects that have been contaminated by Covid-19 sufferers (Sari, 2020).

3. Hand Foot Mouth Disease
   HFMD is a common infectious disease that has infected many people around the world. HFMD is caused by several viruses, specifically Coxsachievirus A16 and Enterovirus 71. This disease usually attacks toddlers under five years old. Symptoms caused by HFMD will appear within 7 to 10 days. Some common symptoms include fever, mouth ulcers, flu, etc. The way this disease is transmitted is by direct contact or objects that have been used by an infected person (Ghanbari, 2020).

4. Meaeles
   Measles is an infectious disease that can be found throughout the world, including in Indonesia, and is considered a health problem that must be resolved. The initial symptoms caused by measles include fever, red eyes, cough, and then followed by reddish spots or rashes on the skin. This infectious disease is caused by the Paramyxovirus genus Morbilivirus. The way measles is transmitted is by direct contact with an infected person (Rohaniah et al., 2020).

5. Chicken Pox
   Chicken Pox is an infectious disease caused by infection by the Varicella-Zoster virus. The virus can be transmitted through the air through droplets from the patient's cough or sneeze and by direct contact with fluid from the blisters (rash) on the patient's skin. The initial symptoms caused by chicken pox are fever, fatigue, and then a red rash (Widayanti and Prastyawati, 2021).

Diagnosis
According to Yanuardi (2019), the meaning of diagnosis can be defined as a process that does not only analyze or identify the type or characteristics, as well as the background to a particular weakness and disease, but implies an effort to predict possibilities and suggest solution actions. Meanwhile, according to Iskandar (2020), diagnosis is a process of finding out what weakness or disease an individual is experiencing through careful testing and study of the symptoms.

Artificial Intelligence
According to Siahaan et al., (2020), Artificial Intelligence is intelligence added to a system that can be managed in a scientific context. Meanwhile, according to Lubis (2021), Artificial Intelligence is a computer system that can carry out tasks that usually require human intelligence. From these two definitions of Artificial Intelligence, it can be concluded that artificial intelligence (Artificial Intelligence) is a condition where a computer can do work and think like humans in general.

Expert System
Expert System is a system designed to imitate the abilities of an expert or specialist so that it can be used to solve problems in a particular field (Marcelina et al., 2022).

Forward Chaining
According to Sanjaya and Falani (2021), Forward Chaining is a form of strategy for searching for solutions to problems in a collection of data or facts in order to create a perception of the future.

Decision Tree
According to Iqbal et al., (2020), Decision Trees are a form of classification method that is quite popular because it is easy to interpret with a very good level of accuracy, as long as the data used is accurate data. Apart from that, according to Husniati et al., (2017), when making a decision using the decision tree approach, the technical completion procedure can be carried out through several steps, namely:
1. Determine a decision tree framework that reflects all the alternatives that can be selected.
2. Determine the magnitude of the opportunities for each branch in the decision tree framework.
3. Determine the expected value starting from the right side to the left side.

Hypertext Preprocessor
Hypertext Preprocessor or PHP can be interpreted as a programming language that uses HTML functions to create a web page (Nestary, 2020).

MySQL
MySQL is an RDBMS (Relational Database Management System) server that allows database users to create, manage, and use data in a relational model (Hermiati et al., 2021).
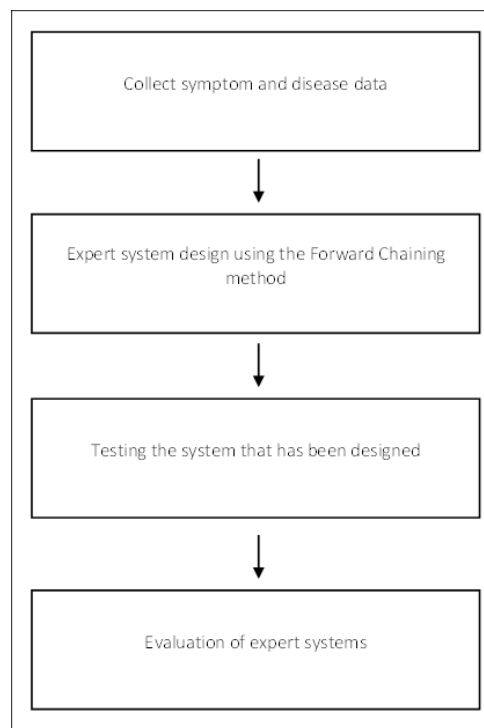
3.0 METHODOLOGY

Figure 1. Research Framework

The design of an expert system begins with collecting disease and symptom data first. Data was obtained from explanations by experts or specialists, as well as using literature studies as a reference. The symptoms obtained are those of Tomato Flu, Covid-19, HFMD (Hand, Foot, and Mouth Disease), Measles, and Chicken Pox. This is because the symptoms of Tomato Flu are similar to other infectious diseases, so it does not rule out the possibility that sufferers experience other infectious diseases. The symptoms that will be used include:

Table 1. Symptom Table

Symptom Code	Symptom Name
G001	Fever
G002	Fatigue
G003	Blistered Skin
G004	Red Rash
G005	Irritation
G006	Dehydration
G007	Cough
G008	Loss of Taste or Smell
G009	Sore Throat
G010	Diarrhea
G011	Hard to Breathe
G012	Muscle Ache
G013	Decreased Appetite
G014	Ulcer
G015	Red Eye
G016	Headache
G017	Nauseous

From this symptom data, it can be grouped based on the symptoms of each infectious disease. The disease data along with the symptoms caused include:

Table 2. Disease Table

Disease Code	Disease Name	Symptom
P001	Tomato Fever	- Fever (G001)
		- Fatigue (G002)
		- Blistered Skin (G003)
		- Red Rash (G004)
		- Irritation (G005)
		- Dehydration (G006)
P002	*Covid-19*	- Fever (G001)
		- Batuk (G007)
		- Fatigue (G002)
		- Loss of Taste or Smell (G008)
		- Sore Throat (G009)
		- Diarrhea (G010)
		- Hard to Breathe (G011)
		- Muscle Ache (G012)
P003	HFMD	- Fever (G001)
		- Sore Throat (G009)
		- Muscle Ache (G012)
		- Decreased Appetite (G013)
		- Ulcer (G014)
P004	Measles	- Fever (G001)
		- Red Eye (G015)
		- Sore Throat (G009)
		- Muscle Ache (G012)
		- Decreased Appetite (G013)
		- Diarrhea (G010)
		- Red Rash (G004)
P005	Chicken Pox	- Fever (G001)
		- Headache (G016)

- Decreased Appetite (G013)
- Muscle Ache (G012)
- Fatigue (G002)
- Nauseous (G017)
- Red Rash (G004)

From the disease table, it is shown that there are several similarities between the symptoms of Tomato Flu and other infectious diseases. So the Forward Chaining method is very necessary because it performs reasoning on the patient's symptom data first, then the system can determine the infectious disease that the patient is suffering from.

In applying the Forward Chaining method, a knowledge base is needed that functions in diagnosing Tomato Flu. A set of knowledge database can be obtained from the symptom table and disease table which shows the relationship between symptoms and diseases in diagnosing Tomato Flu. The knowledge base table is as follows:

Table 3. Knowledge Base Table

Disease / Symptom	P001	P002	P003	P004	P005
G001	Y	Y	Y	Y	Y
G002	Y	Y			Y
G003	Y				
G004	Y			Y	Y
G005	Y				
G006	Y				
G007		Y			
G008		Y			
G009		Y	Y	Y	
G010		Y		Y	
G011		Y			
G012		Y	Y	Y	Y
G013			Y	Y	Y
G014			Y		
G015				Y	
G016					Y
G017					Y

From the knowledge base table a decision tree can be formed. The aim of using a decision tree is to display the results obtained from each search or inspection that has been carried out. The Figure 2 is a decision tree design that will be applied to the system.

From the decision tree design, 5 rules were obtained. From the decision tree design, there are several rules which produce X. X in the decision tree indicates that during the search or examination no diseases were found that were consistent with Tomato Flu, Covid-19, HFMD, Measles, or Chickenpox.

After designing the decision tree, the expert system design stage is then carried out. The implementation of an expert system using the Forward Chaining method will be web-based. The web pages that will be displayed in the expert system are pages that will be designed using the PHP programming language. The use of the expert system will be limited based on the type of access, namely the admin in charge of managing the expert system and the user as the user of the expert system. Some of the pages that will be used in the expert system include the registration page, login page, admin and user home page, disease data page, symptom data page, relationship data page, rules page, consultation and consultation results page, and logout page. Application of the algorithm from the Forward Chaining method will be carried out on the consultation page.

After designing the expert system, then the data from the symptoms and diseases that have been obtained will be entered into the expert system. The data entered will automatically be saved into the MySQL database. The data entered into the expert system includes symptom data, disease data and relationship data.
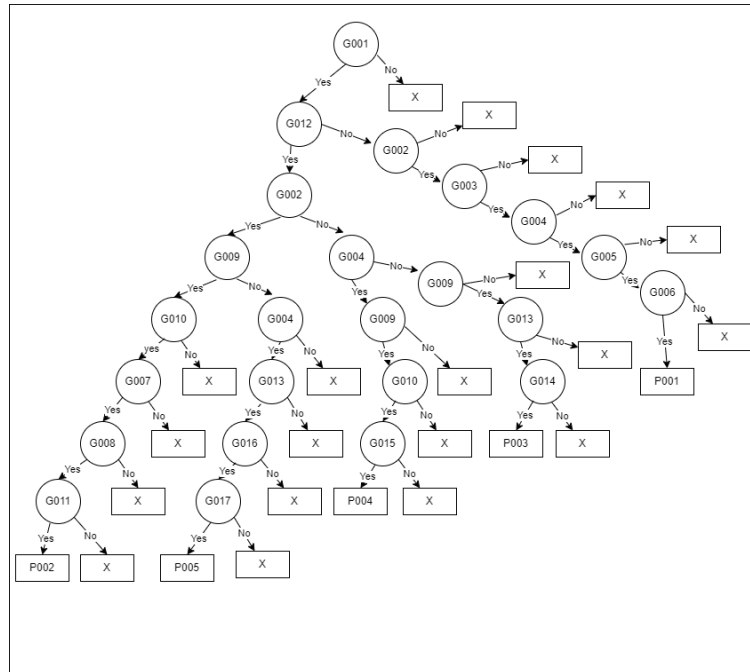
Figure 2. Decision Tree in Expert System

4.0 RESULTS AND DISCUSSION

Expert System Interface
In this section, several pages of the expert system that have been designed will be explained.
1. Consultation Page
   The consultation page is a page aimed at users with a user access type who wish to consult regarding the disease they are suffering from. On the consultation page, the system will display each question related to symptom data that has been stored in the expert system database.

Figure 3. Consultation Page

2. Consultation Results Page
   The consultation results page is a page displayed to users with user access types who have finished answering each question displayed by the system. On the consultation results page, the history of questions, biodata and analysis results are displayed.
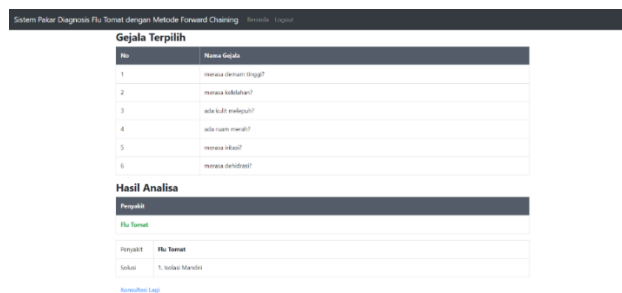

Figure 4. Consultation Results Page

System Testing
System testing is carried out using Blackbox Testing. The following are the results of testing the expert system that has been designed.
1. Login Page

Table 4. Login Page Test Results

Testing Method	Expected Results	Observation	Status
Admin or user enters email, password and access type	Displays the home page based on access type	Displays the home page based on user access type	Succeed

2. Register Page

Table 5. Register Page Test Results

Testing Method	Expected Results	Observation	Status
User enters personal data in the text box provided	User data is saved into the database and the system display Login page	The system displays the Login page	Succeed

3. Disease Data Page

Table 6. Disease Data Page Test Results

Testing Method	Expected Results	Observation	Status
Admin fills in new disease data by pressing the add button on the disease data page.	New disease data is saved into the database and new disease data is displayed on the disease data page.	New disease data is displayed in the disease data table in the expert system.	Succeed
Admin changes existing disease data by pressing the update button on the action of one of the disease data.	Changes in disease data are saved into the database and updated disease data appears on the disease data page.	The updated disease data is successfully displayed in the disease data table in the expert system.	Succeed
Admin deletes existing disease data by pressing the delete button on one of the disease data.	Deleted disease data does not appear in the database and deleted disease data does not appear on the disease data page.	The disease data that was deleted was successfully removed from the disease data table in the expert system.	Succeed

4. Symptom Data Page

Table 7. Symptom Data Page Test Results

Testing Method	Expected Results	Observation	Status
Admin fills in new symptom data by pressing the add button on the symptom data page.	New symptom data is saved into the database and new symptom data appears on the symptom data page.	New symptom data is displayed in the symptom data table in the expert system.	Succeed

Admin updates symptom data by pressing the update button on one of the symptom data.	Changes in symptom data are saved into the database and changes in symptom data are displayed on the symptom data page.	The updated symptom data is successfully displayed in the symptom data table in the expert system.	Succeed
Admin deletes one of the existing symptom data by pressing the delete button	Deleted symptom data does not appear on the database and symptom data page.	The deleted symptom data was successfully removed from the symptom data table in the expert system.	Succeed

5. Relation Data Page

Table 8. Relation Data Page Test Results

Testing Method	Expected Results	Observation	Status
Admin fills in a new combination of disease and symptoms by pressing the add button on the relationship data page.	New combinations of diseases and symptoms are stored in the database and new relationship data appears on the relationship data page.	New relationship data is displayed in the relationship data table in the expert system.	Succeed
Admin updates existing combinations by pressing the update button on one of the relationship data.	Changes in the combination of diseases and symptoms are saved into the database and the updated relationship data appears on the relationship data page.	The updated relationship data is successfully displayed in the relationship data table in the expert system	Succeed
Admin deletes a combination of diseases and symptoms by pressing the delete button on one of the relationship data.	Deleted combinations do not appear in the database and relationship data pages.	The deleted relationship data has been successfully removed from the relationship data table in the expert system.	Succeed

6. Rules Data Page

Table 9. Rules Data Page Test Results

Testing Method	Expected Results	Observation	Status
Admin presses the data rules option on the expert system navigation link.	The system displays the rules data page.	The system displays the rules page.	Succeed
Admin adds relationship data for each disease with its symptoms on the relationship data page.	The system displays the rules for each disease with its symptoms on the rules page.	The system displays the rules for each disease with its symptoms on the rules page.	Succeed

7. Consultation Page

Table 10. Consultation Page Test Results

Testing Method	Expected Results	Observation	Status
The user presses the start consultation button on the home page.	The system automatically directs users to the consultation page and displays questions.	The system displays questions based on previously entered symptom data.	Succeed
User answer questions displayed by the system.	The system stores each user's answer in a database based on the questions displayed by the system.	The system displays a new question when the user has answered the previous question.	Succeed

8. Consultation Results Page

Table 11. Consultation Results Page Test Results

Testing Method	Expected Results	Observation	Status
Users answer all questions displayed by the system.	The system displays results in the form of diseases suffered by the user based on the user's answers.	Displays the results page of the consultation that has been carried out by the user.	Succeed

9. Logout Page

Table 12. Logout Page Test Results

Testing Method	Expected Results	Observation	Status
The admin or user presses the logout option on the expert system navigation link.	The system deactivates (closes) the account of the admin or user and displays the login page.	The system displays the login page again.	Succeed.

5.0 CONCLUSION

The application of the Forward Chaining method in diagnosing Tomato Flu can be carried out and runs according to the expected functionality. The public can carry out consultations well and get results that are in accordance with the rules that have been set so that the expert system can be a solution in easing the work of experts, the number of which is very limited. Apart from that, Admins can also add disease data, symptom data, and relationship data so that it is possible that the expert system can develop in the future. Based on Blackbox Testing test data, results were obtained where each test carried out produced test results with successful status. It is then hoped that the following research can be developed by collecting the latest data related to Tomato Flu. Apart from continuing existing research, you can also apply expert systems with different methods. So it can be used as a comparison between the Forward Chaining method and other expert system methods in diagnosing Tomato Flu.

References

Andreswari, D., Efendi, R., & Prastio, K. (2023). Clustering Data Rekam Medis untuk Penentuan Penyakit Endemi di Daerah Kabupaten Bengkulu Selatan dengan Mengimplementasikan Metode FUZZY C-MEANS. *Jurnal Rekursif*, *11*(1), 42–52. http://ejournal.unib.ac.id/index.php/rekursif/42

Ghanbari, B. (2020). A Fractional System of Delay Differential Equation With Nonsingular Kernels in Modeling Hand-Foot-Mouth Disease. *Advances in Difference Equations*, *2020*(1). https://doi.org/10.1186/s13662-020-02993-3

Hermiati, R., Asnawati, & Kanedi, I. (2021). Pembuatan E-Commerce pada Raja Komputer Menggunakan Bahasa Pemrograman PHP dan Database MYSQL. *Jurnal Media Infotama*, *17*(1), 54–66.

Husniati, N., Judiarni, J. A., & Adhimursandi, D. (2017). Analisis Assigment Problem Berdasarkan Penilaian Kinerja Karyawan Menggunakan Metode Hungarian (Hungarian Method) dan Pohon Keputusan (Decision Tree). *JURNAL MANAJEMEN*, *9*(1), 48–54.

Iqbal, M., Usino, W., & Triono. (2020). Sistem Pendukung Keputusan Menentukan Hasil Budidaya Udang Vaname dengan Metode Algoritma C4.5 (PT Anugerah Sumber Laut Jaya). *Jurnal Tekno Insentif*, *14*(1), 28–39. https://doi.org/10.36787/jti.v14i1.148

Iskandar, A. A. (2020). Diagnosa Penyakit Parasit pada Kucing Menggunakan Metode Certainty Factor (Studi Kasus : Puskewan Cibadak Kabupaten Sukabumi). *Jurnal Teknik Informatika Kaputama (JTIK)*, *4*(2), 126–134.

Lubis, M. S. Y. (2021). Implementasi Artificial Intelligence pada System Manufaktur Terpadu. *SEMNASTEK UISU*.

Marcelina, D., Yulianti, E., & Mair, Z. R. (2022). Penerapan Metode Forward Chaining Pada Sistem Pakar Identifikasi Penyakit Tanaman Kelapa Sawit. *JURNAL ILMIAH INFORMATIKA GLOBAL*, *13*(2), 107–115. https://doi.org/10.36982/jiig.v13i2.2299

Nengsih, Y. G., & Putra, N. (2020). Sistem Pakar Menggunakan Forward Chaining dan Certainty Factor untuk Diagnosa Kerusakan Smartphone. *JURSIMA*, *8*(2), 61–69.

Nestary, N. (2020). Perancangan Sistem Informasi Penjualan pada Toko Stock Point Lily Berbasis PHP MYSQL. *Jurnal Ilmu Komputer Dan Bisnis*, *11*(1), 2320–2337.

Nora Marlim, Y., & Joni Kurniawan, W. (2018). Perancangan Sistem Pakar Untuk Menentukan Kelas pada Anak Berkebutuhan Khusus dengan Metode Fordward Chaining. *JOISIE Journal Of Information System And Informatics Engineering*, *2*(2), 7–15.

Rai Widyasari, K. (2020). Gambaran Tingkat Pengetahuan Tentang Pemeliharaan Kebersihan Gigi dan Mulut serta OHI-S pada Siswa Kelas III SD Negeri 3 Sesetan Tahun 2019. In *POLTEKKES DENPASAR*. POLTEKKES DENPASAR.

Rohaniah, R., Maryam, N. N. A., & Sukmawati. (2020). Pengetahuan dan Sikap Ibu yang Mempunyai Anak Balita Tentang Penyakit Campak. *JKSP*, *3*(1), 37–41.

Sanjaya, M. C., & Falani, A. Z. (2021). Sistem Pakar Untuk Menentukan Paket Layanan Tv Kabel Dan Internet Sesuai Dengan Budget Menggunakan Metode Forward Chaining. *U-NET JurnalTeknikInformatika*, *05*(02), 1–8.

Sapta Permana, I., & Sumaryana, Y. (2018). Sistem Pakar untuk Mendiagnosa Penyakit Kulit dengan Metode Forward Chaining. *JUMANTAKA*, *1*(1), 361–370.

Sari, M. K. (2020). Sosialisasi tentang Pencegahan Covid-19 di Kalangan Siswa Sekolah Dasar di SD Minggiran 2 Kecamatan Papar Kabupaten Kediri. *Jurnal Karya Abdi*, *4*(1), 80–83.

Setyaputri, K. E., Fadlil, A., & Sunardi, D. (2018). Analisis Metode Certainty Factor pada Sistem Pakar Diagnosa Penyakit THT. *Jurnal Teknik Elektro* , *10*(1), 30–35.

Siahaan, M., Jasa, C. H., Anderson, K., Rosiana, M. V., Lim, S., & Yudianto, W. (2020). Penerapan Artificial Intelligence (AI) Terhadap Seorang Penyandang Disabilitas Tunanetra. *Journal of Information System and Technology*, *01*(2), 186–193.

Widayanti, M. R., & Prastyawati, I. Y. (2021). Upaya Peningkatan Pengetahuan Orang Tua Siswa Melalui Pendidikan Kesehatan Tentang Pencegahan dan Penatalaksanaan Cacar Air pada Anak Taman Kanak Kanak. *Jurnal Pengabdian Masyarakat*, *2*(2), 60–68.

Yanuardi. (2019). Rancang Bangun Aplikasi Diagnosa Penyakit Umum Berbasis Android pada Klinik Citra Raya Medika. *Jurnal Teknik Informatika (JIKA)*, 8–17.