DEVELOPMENT OF EXPERT SYSTEM FOR DIAGNOSING THE UNUSUAL BEHAVIOUR OF MULTIPLE CATEGORIES OF EATING DISORDER PATIENTS IN GEN Z USING CERTAINTY FACTOR METHOD

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SKRIPSI

sebagai salah satu syarat untuk memperoleh gelar Sarjana Terapan Komputer
(S.Tr.Kom)
di Program Studi Teknik Informatika
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DAN MANAGEMENT AND SCIENCE UNIVERSITY MALAYSIA

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Truthfully declare that all statements in my thesis report entitled "Development of Expert System for Diagnosing the Unusual Behavior of Multiple Categories of Eating Disorder Patient Gen Z Using Certainty Factor Method" are my own ideas and work with the direction of a supervisory commission, and have never been submitted in any form at any university even.

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MOTTO

“The difficulties in your life are also part of you. So from now on let's forgive ourselves, because we still have a long way to go. Don't give up through this maze of life, believe me after winter passes spring will definitely come."

(Love Myself - BTS)

“As the days passed, nothing went according to my plan. Although the road ahead of me is blurry and foggy, there are many roads ahead of me. Even if the world goes against our direction, we will not get lost, and we will walk in the right direction. Let's go together!”

(Together - Seventeen)

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6. Mukhamad Angga Gumilang S.Pd., M.Eng. (Supervisor I) and Madam Safwati binti Semaail (Supervisor II).

This Scientific Writing Report is still imperfect, expect criticism and constructive suggestions for future improvement. Hopefully this article is useful.

Jember, 23 June 2024

(Vindy Amelia Putri)

DEVELOPMENT OF EXPERT SYSTEM FOR DIAGNOSING THE UNUSUAL BEHAVIOUR OF MULTIPLE CATEGORIES OF EATING DISORDER PATIENTS IN GEN Z USING CERTAINTY FACTOR METHOD

Supervisor by Mukhamad Angga Gumilang S.Pd., M.Eng. and Madam Safwati binti Semaail

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ABSTRACT

The increasing prevalence of eating disorders among Generation Z necessitates advanced diagnostic tools to identify and address these issues effectively. This research focuses on the development of an expert system that leverages the Certainty Factor method to diagnose unusual behavior across multiple categories of eating disorders specifically within the Gen Z demographic. The system aims to enhance early detection and provide accurate diagnoses by incorporating a wide range of symptoms and behavioral indicators. The Certainty Factor method allows for handling uncertainty and partial truths, making the system robust and reliable. Preliminary results indicate that the expert system significantly improves diagnostic accuracy compared to traditional methods, offering a valuable tool for healthcare providers in managing and treating eating disorders among young individuals.

Keywords : Expert system, Eating Disorder, Certainty Factor

SUMMARY

Development of Expert System for Diagnosing the Unusual Behaviour of Multiple Categories of Eating Disorder Patiens in Gen Z Using Certainty Factor Method, Vindy Amelia Putri, NIM E41200760, Tahun 2024, 53 Hal, Teknologi Informasi, Politeknik Negeri Jember, Mukhamad Angga Gumilang S.Pd., M.Eng. (Supervisor I) and Madam Safwati binti Semaail (Supervisor II).

Expert systems have played an important role in medicine. Rather than solely relying on medical doctors, expert diagnostics systems are now being developed to diagnose these diseases and offer expert advice to the patients. These diagnostic systems are being used in medical centers and clinics while some are open source for use by anyone. Expert diagnostics systems aren't developed to eliminate the need for doctors but can even assist the doctors or medical personnel in making faster and reliable diagnosis. It could also be of great use to patients who live in areas where access to doctor is limited and very expensive.

The number of patients with eating disorders has been increasing globally for the past 50 years. Since the 1980s, there has been an increase in the prevalence of eating disorders in the Asian population. Surprisingly, Indonesia ranks 4th in the world below the USA, India, and China. To address these challenges, the goal is to use information technology by designing a web-based expert system for diagnosing unusual behaviors across multiple categories of eating disorders using the Certainty Factor method. This system aims to make it easier for individuals to recognize symptoms and types of eating disorders without needing to visit a doctor directly. Additionally, it provides solutions to help prevent the onset of eating disorder.

PREFACE

First and foremost, I would like to express my deepest gratitude to my parents; Dedy Iskandar and Sasi Wiyati, also my brother Kevin Alvino Dwi Fahreza for their unwavering support and encouragement throughout my academic journey. Their love, guidance, and sacrifices have been the cornerstone of my achievements. Without their constant belief in me, this work would not have been possible.

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CHAPTER 1

INTRODUCTION

1.1 Project Background

In this digital era, the rapid development of computer technology has encouraged its widespread use and utilization in various fields, including medicine and health. Computers, which were originally only used for data processing and mathematical calculations, can now be utilized as a provider of solutions to inputed problems (Muniar, n.d.). Through out its development, computers have various functions, one of which is its ability to act like an expert or specialist. The application of expert systems in the field of medicine or health can involve disease diagnosis and providing solution recommendations based on the available diagnosis results (Kirman et al., 2019).

Expert systems have significantly contributed to the field of medicine. Instead of depending solely on medical professionals, advanced diagnostic systems have emerged to diagnose diseases and provide expert guidance to patients. These diagnostic tools are utilized in medical facilities and clinics, with some being available as open-source resources for broader accessibility. The purpose of expert diagnostic systems is not to replace doctors but to support them in achieving quicker and more accurate diagnoses. They can also be particularly beneficial for patients residing in regions with limited and costly access to healthcare services. (Azeez et al., 2019).

Eating disorders are mental health conditions that have significant psychological and medical implications. Conditions like anorexia nervosa (AN) and bulimia nervosa (BN) are enduring illnesses characterized by disruptions in eating patterns or difficulties in weight management. The Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV), categorizes three forms of eating disorders: anorexia nervosa (AN), bulimia nervosa (BN), and binge-eating disorder (BED). AN is characterized by a refusal to maintain a normal weight, distorted body image, extreme fear of becoming fat, and highly disturbed eating behavior. BN is

characterized by eating large amounts of food often and repeatedly, then trying to vomit it back up, using laxatives, fasting, or excessive exercise (Krisnani et al., 2018). Examples of common eating disorders include extreme dieting, overeating or binge eating, fasting, calorie counting, and self-induced vomiting.

Over the last five decades, there has been a global rise in the number of individuals affected by eating disorders. Particularly since the 1980s, there has been a noticeable uptick in the prevalence of eating disorders within the Asian population. More recently, there has been a surge in the occurrence of eating disorders among young women in Singapore. In Singapore, the prevalence of young women at risk of developing eating disorders stands at a significant 7.4%. In 2007, a Singaporean media outlet highlighted a six-fold increase in teenagers grappling with eating disorders since 2002. Singapore General Hospital records indicate approximately 140 cases of eating disorders annually, yet only 10 to 20% of individuals seek treatment for these conditions. 0.05% of psychiatric patients in Malaysia had been diagnosed with AN, and this figure did not increase for 15 years (Krisnani et al., 2018). In Indonesia, 12-22% of women aged 15-29 suffer from chronic energy deficiency (BMI <18.5) in some areas (Atmarita, 2005). Surprisingly, Indonesia ranks 4th in the world below the USA, India, and China (Chairani, 2018).

In Indonesia, There haven't been many studies regarding eating disorders resulting from deviant eating behavior as it is still considered a trivial issue and not many cases have been revealed. In a quantitative study on the tendency of deviant eating behavior among teenagers in Jakarta, it was stated that 34.8% of teenagers in Jakarta experience deviant eating behavior, with 11.6% suffering from anorexia nervosa and 27% suffering from bulimia nervosa (Melani et al., 2021). However, it is difficult to know the exact statistics of the incidence of this disorder in Indonesia. Whether this deficiency is caused by eating disorders or other things is not explained in detail. However, there is still a lack of research on eating disorders in Indonesia, so its prevalence is not known for certain.

Given the problems outlined, I am interested in solving these issues by utilizing information technology, namely designing an expert system to diagnose unusual behavior of multiple categories of eating disorder patients using the certainty factor method and based on the web. With this system, it can make it easier for

people to know the symptoms and types of eating disorders without having to meet a doctor directly, and can also know the solution to prevent the occurrence of eating disorders.

1.2 Problem Statement

1. Many people with eating disorders difficulties in obtaining accurate diagnoses.
2. There was no preparation which resulted in the absence of appropriate treatment records.
3. Some people find it difficult to track their own progress effectively.

1.3 Objective of the Project

1. To create an expert system that can be used to diagnose eating disorders.
2. To suggest the treatment based on eating disorder category.
3. To provide tracking on the improvement based on acitivity by the user.

1.4 Significance of the Project

Contribution to understanding eating disorders : This project has significant theoretical impact as it will contribute to our understanding of eating disorders, particularly among the Generation Z. Eating disorders are a mental health issue that is becoming increasingly relevant in modern society, and this project will help identify unusual behaviors related to it.

Early detection and intervention: The expert system can aid in the early detection of eating disorders in Generasi Z individuals. Early intervention is crucial for successful treatment outcomes and preventing the progression of these disorders, which can have severe physical and mental health consequences.

Improving diagnostic effects: This expert system can be used as an aid for mental health professionals in diagnosing eating disorders, allowing them to focus more on other aspects of patient care.

Increasing access to care: With this system, individuals who may not have direct access to professionals, also can gain initial insights into their condition and seek further help if needed.

Fulfilling public health service needs: This project will help meet the needs of public health services by providing an expert system for diagnosing eating disorders. It can also accelerate better medical responses and more efficient handling.

1.5 Scope of the Project

1.5.1 User Scope

- User are required to register first
- User can login to existing account
- User can manage their profile
- User can answer the questionnaire set
- User can view result after they answer the questionnaire
- User can view treatment
- User can view detection history

1.5.2 System Scope

- **Eating disorder classification**: This project will include the development of an expert system that can identify and analyze various types of eating disorders, including anorexia nervosa, bulimia nervosa, binge eating disorder, and other eating disorders that may exist among the Generation Z.
- **Questionnaire Set**: Based on the answers given in the questionnaire set, the expert system can analyse and determine a possible diagnosis.
- **Diagnosis Result**: The system will provide diagnostic results to the user based on the symptoms or information that has been inputted.
- **History of Diagnosis**: The diagnosis history can be used to monitor the user's progress. By looking at the previous history, users can see if any changes have occurred, as well as compare them with the current examination results.
- **Treatment Recommendations**: The system will provide appropriate treatment recommendations based on the given diagnosis. These recommendations may include psychological therapy, family support, and changes in eating patterns.
- **Patient Information Collection**: The system will allow users to input patient information, including observed symptoms, behaviors, and risk factors. This information will be used as a basis for diagnosing patients.

1.6 Assumptions and Limitations

In the context of the "Development of Expert System for Diagnosing Unusual Behaviour of Multiple Categories of Eating Disorder Patients in Gen Z Using Certainty Factor Method" project, several key assumption and limitations are recognized, which frame the project's scope and potential constraints:

1.6.1 Assumptions

- **Patient Data Availability**: The assumption is that patient data with eating disorders among Generation Z is available and accessible for the purpose of this research. This data includes information about eating behavior, medical history, and eating disorder-related data.
- **Patient Compliance:** The assumption is that patients will provide accurate and honest information about their eating disorder-related behavior. Patient compliance in providing relevant information is important for accurate diagnosis.
- **Successful Clinical Implementation**: The assumption is that the developed expert system can be effectively implemented in clinical settings and provide benefits in diagnosing eating disorders in patients.
- **Inability to Distinguish from Other Diseases**: The assumption is that the expert system will be able to distinguish eating disorder symptoms from other diseases that have similar symptoms.
- **Data Security and Privacy:** The assumption is that patient data security and privacy will be well maintained in accordance with ethical and legal guidelines applicable to this research.

1.6.2 Limitations

- **Limited Medical Knowledge:** This expert system depends on the medical knowledge available at the time of development. Limitations in certain medical understanding or research may affect the accuracy and comprehensiveness of the diagnosis.
- **Eating Disorder Category Changes and Additions:** Over time, there may be changes or additions to the medically recognized classifications of eating disorders. The system may not automatically be able to accommodate these changes without manual updates.

- **Depends on Accurate Input Data:** The accuracy of the system in diagnosing depends on the accuracy and completeness of the data entered by the user or mental health professional. Inaccurate or incomplete data may affect the diagnosis results.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is a crucial component in a research that aims to present and analyze literature reviews that are relevant to the research topic. In this chapter, the author will explore various sources such as scientific journals, books, articles, and other publications related to this project. Through this literature review, the author will identify relevant theoretical frameworks and fill in existing knowledge gaps.

2.2 Explanations of key terms and terminologies

1. Expert system : Intelligent systems is the science dealing with the creation of intelligent machines. An intillegent machine can be interpreted as a machine that can do certain things that require intelligence when done by humans. An expert system or an intelligent system designation by applying several methods, will produce a system that can provide the best solution recommendations. Expert systems also have many methods and algorithms that are adapted to various cases (Akbar & Mukhtar, 2020),
2. Eating disorder : Eating disorder is a symptom of abnormal eating patterns. Eating disorder is defined as a disorder that occurs in eating habits a person that is caused by concern of the person. There are three types of eating disorders according to DSM-5 (Diagnostic and Statistical Manual Of Mental Disorder, 2014) namely : Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder (Noe & Kusuma, 2019)
3. Certainty factor : The Certainty Factor is a technique used to quantify the level of certainty regarding facts or rules, reflecting an expert's confidence in addressing the current issue. It serves as a metric indicating the degree of certainty associated with a specific fact or rule. (Sucipto et al., 2019).
4. Generation z : Generation Z is the generation born between 1995 and 2010. Some of them are entering the developmental phase of adolescence and early adulthood (Alfaruqy, 2022).

2.3 Reviewing of Relevant Literature and Technologies

In 1994, the American Psychiatric Association through the Diagnostic and Statistical Manual of Mental Disorders (DSM) IV described two specific categories of eating disorder diagnosis, namely Anorexia Nervosa and Bulimia Nervosa, while Binge Eating Disorder is a new category in DSM-5 for eating disorder diagnosis, which was previously part of EDNOS. (Goutama, 2016).

Anorexia nervosa is an eating disorder characterised by self-starvation. Anorexia Nervosa is a disorder characterised by deliberate weight loss, which is initiated and/or maintained by the patient. Anorexia nervosa is an eating disorder characterised by body image disturbance and severe food restriction (Krisnani et al., 2018).

Bulimia nervosa is an eating disorder characterised by persistent attempts to regurgitate what has been eaten. Bulimia nervosa is a syndrome characterised by recurrent bouts of binge eating behaviour and excessive preoccupation with weight (Krisnani et al., 2018).

Binge eating disorder is defined as an episode of eating a larger quantity of food than most people can eat in the same time period or under the same conditions, followed by a feeling of loss of control during the eating process and recurring over a short period of time that occurs at least once a week for three months. Unlike the previous two categories of eating disorders, BED patients are not known to have an excessive desire to achieve thin body proportions, or compensatory behaviours after binge eating, such as attempting vomiting, excessive dietary restriction, or using laxatives to expel food that has been eaten (Goutama, 2016).

2.3.1 Review of Current Relevant Method

The journal entitled "Expert System for Diagnosing Gastric Diseases and Their Handling Using the Dempster Shafer Method" discusses the use of an expert system in diagnosing gastric diseases and their treatment using the Dempster-Shafer method. The search for disease symptoms is carried out using the Dempster-Shafer method, where this method works to compare all the symptoms of the disease suffered by the user. The result of this comparison is taken the highest probability / degree of confidence of the disease. The Dempster-Shafer method is a mathematical theory used to overcome uncertainty in decision making. This method is based on belief functions and reasonable thinking (Kirman et al., 2019)

The journal entitled "Application of an Expert System to Diagnose Digestive Diseases with Natural Medicine" discusses the application of an expert system in diagnosing digestive diseases with treatment from natural ingredients using the forward chaining method. Forward Chaining is a search strategy that commences by considering established facts, which are then compared with the conditions stipulated in the IF segment of IF-THEN rules. Upon identifying a fact that aligns with the IF condition, the corresponding rule is triggered. Upon execution of a rule, a new fact (the THEN part) is integrated into the database. Each match initiates from the topmost rule, and each rule is executed only once. The matching process ceases when no further rules can be applied. Various search techniques such as Depth-First Search (DFS), Breadth-First Search (BFS), or Best First Search are employed in this process. If the conditions specified in the rule are met (true value), the conclusion is affirmed. Forward chaining is particularly advantageous when an application generates a broad but shallow tree structure. (Muniar, n.d.).

The journal entitled "Analysis of Expert System Methods for Determining Types of Internal Diseases with the Certainty Factor Method" discusses the analysis of expert system methods used to determine the type of internal disease using the Certainty Factor method. Diagnosis is done by analyzing symptom input from patients through questions related to what the patient is suffering from. The input symptoms will be processed using predetermined rules based on expert or doctor knowledge. The result of this expert system is one type of disease that has the largest Certainty Factor value (Hidayat & Kriestanto, 2017).

2.3.2 Review of Practical Research

“Silicosis Expert System Diagnosis and Treatment” The research paper discusses the development of an expert system for diagnosing silicosis. The expert system incorporates a knowledge base and a set of rules to diagnose the disease based on symptoms. The system uses SL5 Object language and has been evaluated by specialists in lung diseases, with highly satisfactory results. The paper also discusses the use of similar expert systems for diagnosing various diseases, highlighting the importance of accurate diagnosis and treatment. The expert system is user-friendly and does not require intensive training to use, making it a valuable tool for both patients and healthcare providers. Overall, the paper presents the development and evaluation of an expert system for diagnosing silicosis and highlights its potential to

improve the accuracy and efficiency of disease diagnosis and treatment (Kahlout et al., 2019).

"Anemia Expert System Diagnosis Using Sl5 Object" The paper discusses anemia and the classification of its types based on causes, morphology of red blood cells, and clinical manifestations. It introduces an expert system utilizing artificial intelligence to diagnose five anemia diseases across various stages of life and describes the knowledge base and inference engine of such a system. Additionally, the paper highlights the lack of specialized expert systems for anemia, detailing the main symptoms of the condition. It emphasizes the need for a simple and accessible diagnostic system and the potential for future expansion to include more anemia diseases. The system aims to aid physicians in diagnosing anemia and is developed using SL5 language (Ahmed & Naser, 2019).

"Lower Back Pain Expert System Diagnosis And Treatment" The paper presents the development of an expert system using SL5 Object language, which includes a user interface, explanation subsystem, knowledge base, and inference engine. The system is designed to ask users yes/no questions and provides a diagnosis and recommendation based on the input. The knowledge for the expert system was sourced from physicians and specialized websites for lower back pain, and the system has undergone preliminary testing with positive feedback from medical students (Naser & AlDahdooh, 2016).

2.4 Review of Similar Products or Systems

1. Medscape

The Medscape app is a mobile application designed specifically for medical personnel, such as doctors, nurses, pharmacists, and other healthcare professionals. The app provides access to a wide range of medical resources useful in clinical practice, medical decision-making, and continuing education. The Medscape app provides a variety of features and content including drug information, clinical guidelines, research articles, health news updates, medical calculator tools, and continuing education (CME) programs. The content is curated by a team of medical experts and updated regularly to ensure accuracy and currency of information.

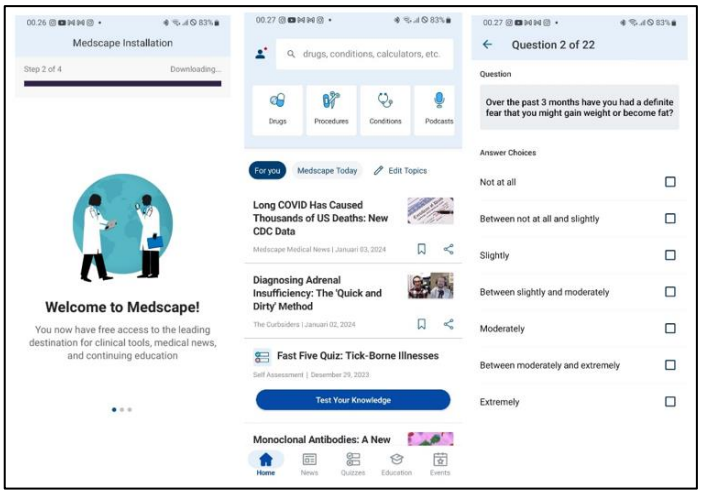

Figure 2. 1 Medscape Application

2. Eating Disorder Test

Eating Disorder Test is an app designed to assist users in evaluating and identifying possible eating disorders. The app provides questionnaires or tests designed by health professionals or eating disorder experts. In the Eating Disorder Test app, users will be asked to answer a series of questions relating to eating behaviors, eating patterns, food-related thoughts and feelings, body image, and other factors related to eating disorders. Based on the user's answers, the app will provide a result or score that indicates the possible presence of an eating disorder.

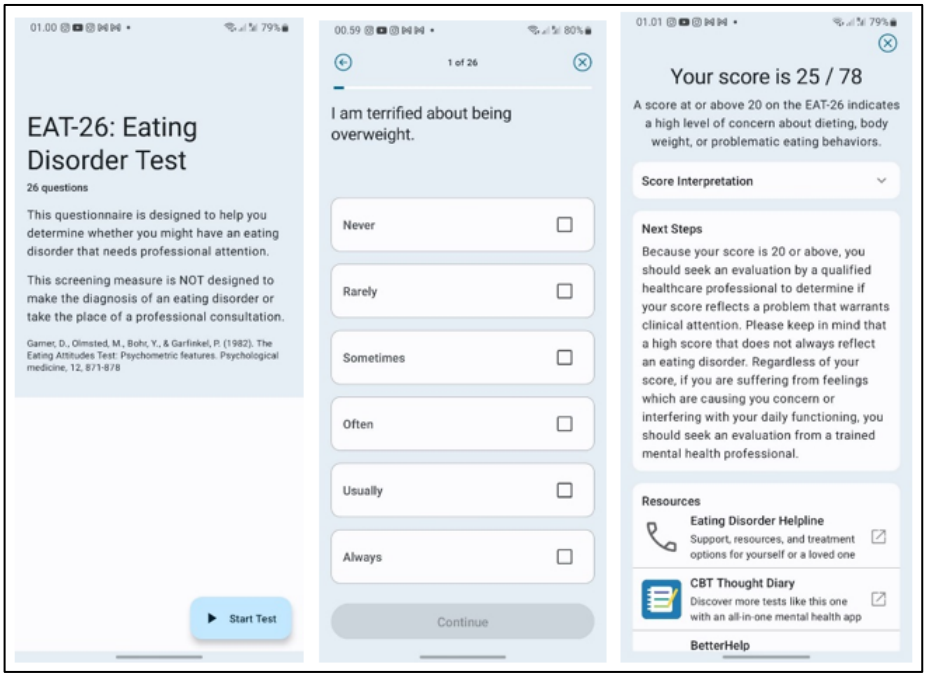

Figure 2. 2 Eating Disorder Test Application

3. Eating Attitude Test (EAT-26)

The Eating Attitudes Test (EAT-26) is a questionnaire or test used to evaluate eating-related attitudes and behaviors in individuals. The test is designed to help identify the possible presence of eating disorders. The EAT-26 consists of 26 questions that cover various aspects related to eating, including eating patterns, eating control, food-related anxiety, body image, and attitudes toward food. Each question has answer choices that describe the level of frequency or severity of eating-related behaviors or thoughts.

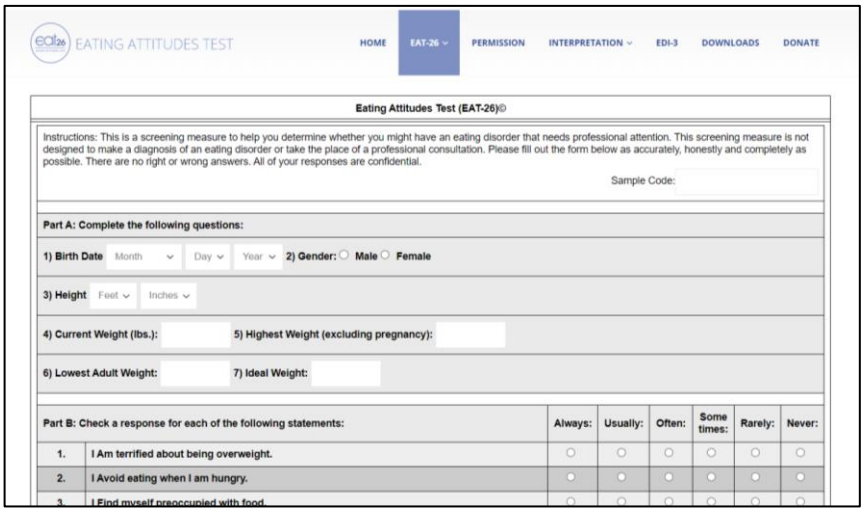

Figure 2. 3 Website Eating Attitude Test (EAT-26)

2.4.1 Comparison of Similar

Table 2. 1 Comparation Related Product

Features	Medscape	EDT	EAT-26	Proposed System
Login	**Yes** Have login on first time using the app for users	**No** Don't have login on first time using the app for users	**No** Don't have login on first time using the app for users	**Yes** Have login on first time using the app for users
Register	**No** If user do not have an account they	**No** If user do not have an account they	**Yes** If user do not have an account they	**Yes** If user do not have an account they

	cannot register it first	canoot register it first	can register it first	can register it first
Questionnaire set	**Yes** Have a questionnaire set to collect data and determine the diagnosis	**Yes** Have a questionnaire set to collect data and determine the diagnosis	**Yes** Have a questionnaire set to collect data and determine the diagnosis	**Yes** Have a questionnaire set to collect data and determine the diagnosis
Diagnosis result	**Yes** Will show the diagnosis result after fill up the questionnaire set	**Yes** Will show the diagnosis result after fill up the questionnaire set	**Yes** Will show the diagnosis result after fill up the questionnaire set	**Yes** Will show the diagnosis result after fill up the questionnaire set
Treatment	**No** Not display treatment suggestions according to the diagnosis results	**Yes** Will display treatment suggestions according to the diagnosis results	**No** Not display treatment suggestions according to the diagnosis results	**Yes** Will display treatment suggestions according to the diagnosis results
History	**No** Not show the diagnosis history	**Yes** Will show the diagnosis history	**No** Not show the diagnosis history	**Yes** Will show the diagnosis history
Logout	**Yes** Have log out to leave the app	**No** Don’t have log out to leave the app	**No** Don’t have log out to leave the app	**Yes** Have log out to leave the app

From the comparison table above, it can be seen that there are many systems with incomplete features. Most of the above expert systems prioritize diagnosis

without treatment. Therefore, the purpose of this new system is to diagnose and provide appropriate treatment. In addition, this system will keep track of the improvement based on activity by the user.

CHAPTER 3

METHODOLOGY

3.1 Software Development Methodology

Software Development Methodology plays an important role in the development of "Development of Expert System for Diagnosing the Unusual Behaviour of Multiple Categories of Eating Disorder Patients in Gen Z Using Certainty Factor Method". The goal is to ensure structured, planned, quality development and in accordance with the expected results in improving accuracy in diagnose. "Development of Expert System for Diagnosing the Unusual Behaviour of Multiple Categories of Eating Disorder Patients in Gen Z Using Certainty Factor Method" using the Extreme Programming method allows measurable results and ensures the expert system development process goes well. In this case, system development can be more flexible, collaborative and scalable as well as respond to changes and continue to improve the accuracy of the expert system over time. Using this agile method can easily adjust and respond to changes through short sprint iterations. So it can be easy to focus on improving accuracy in each sprint and improve or adjust algorithms based on feedback and evaluation results of each sprint. The use of this software method is to ensure effective object system development, responsive to change, and focused on measurable results as well as designing better solutions and improving expert system performance.

3.1.1 Chosen Methodology and Justification

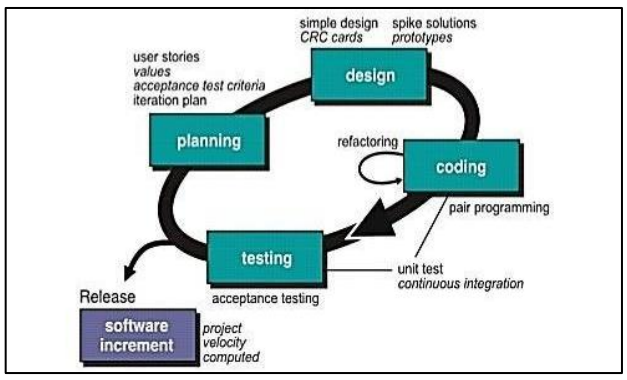

Figure 3. 1 Extreme Programming Methodology

In this project will be using a project management called Extreme Programming. Extreme programming is one of the development methods derived from agile development. Extreme Programming (XP) is a software engineering development method that targets teams formed on a small to medium scale, and this method can also be used for system development with unclear requirements or changes to requirements very quickly. XP is a method that has a good level of responsiveness to change. The advantages of the XP method also offer stages in a short processing time in accordance with the focus to be achieved. The stages of software development with XP are: planning, design, coding, and test (Septiani & Habibie, 2022).

3.1.2 Step by step Explanation of Phases the Chosen Methodology

There are several steps of Extreme Programming, which will be explained below

1. Planning: This initial stage marks the outset of system development, encompassing a series of preparatory tasks including issue identification, needs analysis, and scheduling for system implementation. During the planning phase, the process typically begins with gathering a set of system activity requirements to facilitate user comprehension of business operations, delineate key features, functionalities, and desired outcomes of the system.
2. Design: The subsequent phase is the design stage, during which modeling tasks are undertaken, ranging from system modeling and architectural modeling to database modeling.
3. Coding: This stage is an activity of applying the modelling that has been made into the form of a user interface using a programming language.
4. Testing: Following the completion of the coding stage, the system undergoes testing to identify any errors that may occur during application execution and to ascertain whether the developed system aligns with user requirements.

3.2 Research Methodology

The chosen research methodology used in this project is a combination of two methodologies, which are qualitative research and quantitative. In this project, qualitative methods can be used to collect qualitative data such as symptoms, classification, and treatment. Whereas quantitative methods involve the use of numbers and statistics in data analysis. In this project, quantitative methods can be used to calculate the certainty factor (CF) which is one of the tools in expert systems

to measure the level of confidence in a diagnosis. CF describes how strong the relationship is between the symptoms and the diagnosed condition.

The steps of doing the research using this methodology is explained below:

1. Research Design: The initial stage was to design a research design that combined quantitative and qualitative elements. This involves selecting participants, collecting data, and timing each method appropriately.
2. Data collection: The next stage is qualitative and quantitative data collection. Data collection is done through interviews with experts.
3. Data analysis: After data collection, the next step is to analyze the data that has been obtained.
4. Data Integration and Interpretation: The next stage is to integrate and interpret the quantitative and qualitative data. This involves comparing and contrasting the findings from both types of data to gain a more comprehensive understanding.
5. Conclusions and Implications: The final stage is to draw conclusions and implications from the research. In this stage, findings from both types of data are combined to summarize the results of the research and provide practical or theoretical implications.

3.2.1 Justification of a Chosen Methodology

There are several reasons why this research methodology is chosen as the way to finish the project, which are:

1. Cross Validity: Combining qualitative and quantitative methods allows for cross validity or triangulation. Cross validity occurs when data from different methods mutually reinforce and confirm each other's findings. By using these two methods, research can obtain stronger and more reliable evidence about eating disorders.
2. More Complete Data: By using mixed methods, researchers can collect more complete and diverse data.
3. Relevance of results to context: A blended approach helps ensure that the research or development results remain relevant to the specific context of the project and the needs of the end-users.
4. Flexibility: Mixed methods give the researcher the flexibility to tailor the research approach to the context and objectives of the study.

3.2.2 Interview Design and Samples

The interview was conducted online, via halodoc with the expert as the interviewee. Halodoc is an application and website engaged in the health sector. Halodoc offers a variety of services, including online doctor consultations.

Figure 3. 2 Interview Session

Source Person Name:		Patricia Elfira Vinny S.Psi, M.Psi, Psikolog
Major	:	Psikolog
Practice Field	:	1. Mitra Keluarga Hospital, Banten, Indonesia
		2. Royal Progress Hospital, North Jakarta, Indonesia
Date Interview	:	5 January 2024
Place of Interview	:	Video Call Halodoc

3.2.3 Analysis of Interview

The results of interviews conducted with experts in the form of symptom data and disease data which will be displayed in the table below.

Table 3. 1 Symptoms Data

Symptom Code	Symptom
G01	Extreme weight loss that is not in line with weight standards
G02	Frequently skipping meals and making excuses not to eat
G03	Enjoys cooking food for others but doesn't eat herself
G04	Reluctant to eat in public
G05	Only eat certain foods
G06	Having excessive fear of weight gain
G07	Have a habit of weighing yourself repeatedly
G08	Often look in the mirror to find your own shortcomings
G09	Often complains of being overweight where others think it is not the case
G10	Tends to lie about how much food has been consumed
G11	Very concerned with weight and body shape
G12	Always think negatively of their own body shape
G13	Fear of being fat or feeling overweight
G14	Often get out of control when eating, such as continuing to eat until your stomach hurts or eating excessive portions.
G15	Frequent rush to the bathroom after meals
G16	Forcing oneself to vomit, especially by inserting a finger into the esophagus
G17	Exercising excessively
G18	Using laxatives, diuretics, or enemas after meals
G19	Using supplements or herbal products for weight loss
G20	Have cuts, scars or calluses on knuckles or hands
G21	Eating large meals over a period of time such as a 2-hour period
G22	Chews much faster than normal people
G23	Eating to the point of feeling too full and making your stomach growl
G24	Can eat large portions even when not hungry
G25	Eating secretly because she was embarrassed by the amount of food.
G26	Feeling disgusted, depressed, ashamed, upset or guilty about yourself

	after eating
G27	Frequent dieters but find it difficult to stick to a diet and lose weight
G28	Hoarding food
G29	Feeling sensitive, upset or angry when talking about food or hearing about body shaming
G30	Having feelings of anxiety, hopelessness, and low self-confidence
G31	Sudden or severe restriction of the type or amount of food eaten
G32	Will only eat foods with a certain texture
G33	Vomiting while eating, or fear of choking
G34	Decrease in appetite or interest in food
G35	A small number of preferred foods that decrease over time (i.e. pick and choose foods that get worse)
G36	No body image anxiety or fear of weight gain

Table 3. 2 Disease Data

Disease Code	**Disease**
P01	Anorexia Nervosa
P02	Builimia Nervosa
P03	Binge Eating Disorder
P04	ARFID

Table 3. 3 Knowledge Base Data

Symptom	**Disease**			
	P1	P2	P3	P4
G01	✓			
G02	✓			
G03	✓			
G04	✓	✓		
G05	✓			
G06	✓			
G07	✓			

G08	✓			
G09	✓			
G10	✓			
G11		✓		
G12		✓		
G13		✓		
G14		✓		
G15		✓		
G16		✓		
G17		✓		
G18		✓		
G19		✓		
G20		✓		
G21			✓	
G22			✓	
G23			✓	
G24			✓	
G25			✓	
G26			✓	
G27			✓	
G28			✓	
G29			✓	
G30			✓	
G31				✓
G32				✓
G33				✓
G34				✓
G35				✓
G36				✓

3.2.4 Proposed System Requirements

Table 3. 4 Requirement List

No	Requirement Description	Type (Functional/Non Functional/Usability)	Stakeholder
1	User can open the web	Functional	User
2	Users can log in and out of the system using their account.	Functional	User
3	Questionnaire Set Test; User can test their symptoms using questionnaire set	Functional	User
4	User can log and track their symptoms, behaviours, and emotional states related to eating disorder	Functional	User
5	Progress Monitoring; tools for tracking progress over time, including goal setting, journalling, and visual representation	Functional	User, System
6	Data privacy and security, system is compilated with data protection regulations, encryption of user data, and securing storage of sensitive information	Functional	System
7	The system must have a knowledge base consisting of rules obtained from experts in the field of eating disorders.	Functional	System
8	The system should be able to provide an accurate diagnosis based on the patient's symptoms and eating behavior.	Functional	System
9	The system should be able to provide treatment recommendations and appropriate actions based on the diagnosis given.	Functional	System
10	The application should be available and	Non-Functional	System

	functional 24/7 with minimal downtime for maintenance or upgrades.		
10	The system needs to experience as minimum bug as possible	Non-Functional	User
11	The system must at least have 97% of success in operating each week	Non-Functional	User
12	The date format in the application should be following the format of date, month, and year	Non-Functional	User
13	UI/UX of the aplication should be easy for people to understand	Usability	User
14	Any icon related of the application (such as profile icon, cart icon) should be commonly known and accessible for everyone	Usability	User
15	Every error needs to be addressed clearly in the app	Usability	User

3.3 Proposed System Design

The system design of this project is drawn below:

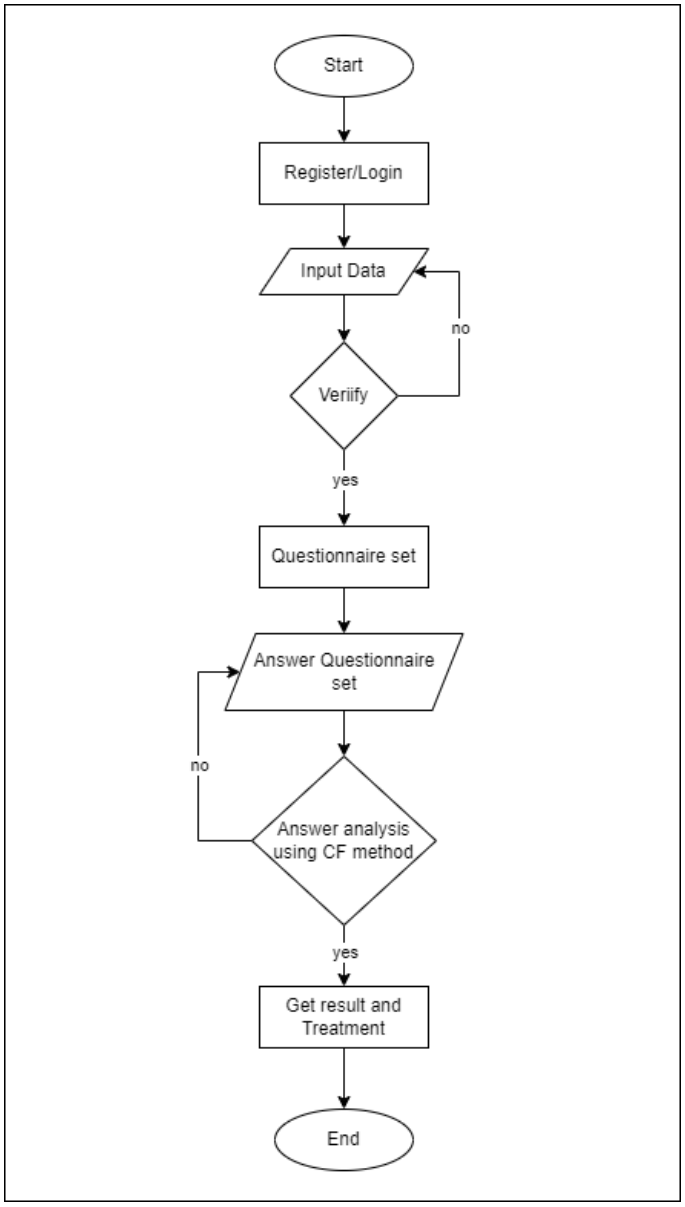

Figure 3. 3 Flowchart System

Based on the figure 3.3, the system design is explained:

The flow of the expert system application begins with the user registering or logging in. The user will fill out a questionnaire in the form of questions about the symptoms experienced, such as significant changes in eating patterns. The expert system will perform symptom analysis using the certainty factor method based on user answers and determine the possibility of eating disorder. After analysing, the application will

provide diagnosis results and treatment recommendations to users. The application flow will end with the user exiting the expert system.

3.3.1 UML Modelling of the Proposed System

1. Use Case Diagram

Figure 3. 4 Use Case Diagram

The use case diagram below explains the connection between actors and the entities inside of it. From the Figure 3.4, we can conclude that there are two actors, which are:

a. User, which can:
    a. Login
    b. Answer and Submit Questionnaire Set
    c. See Treatment

b. System, which can:
   a. Show Menu
   b. Show Questionnaire Set
   c. Processing Questionnaire Answer
   d. Show Result
   e. Show Treatment

2. Class Diagram

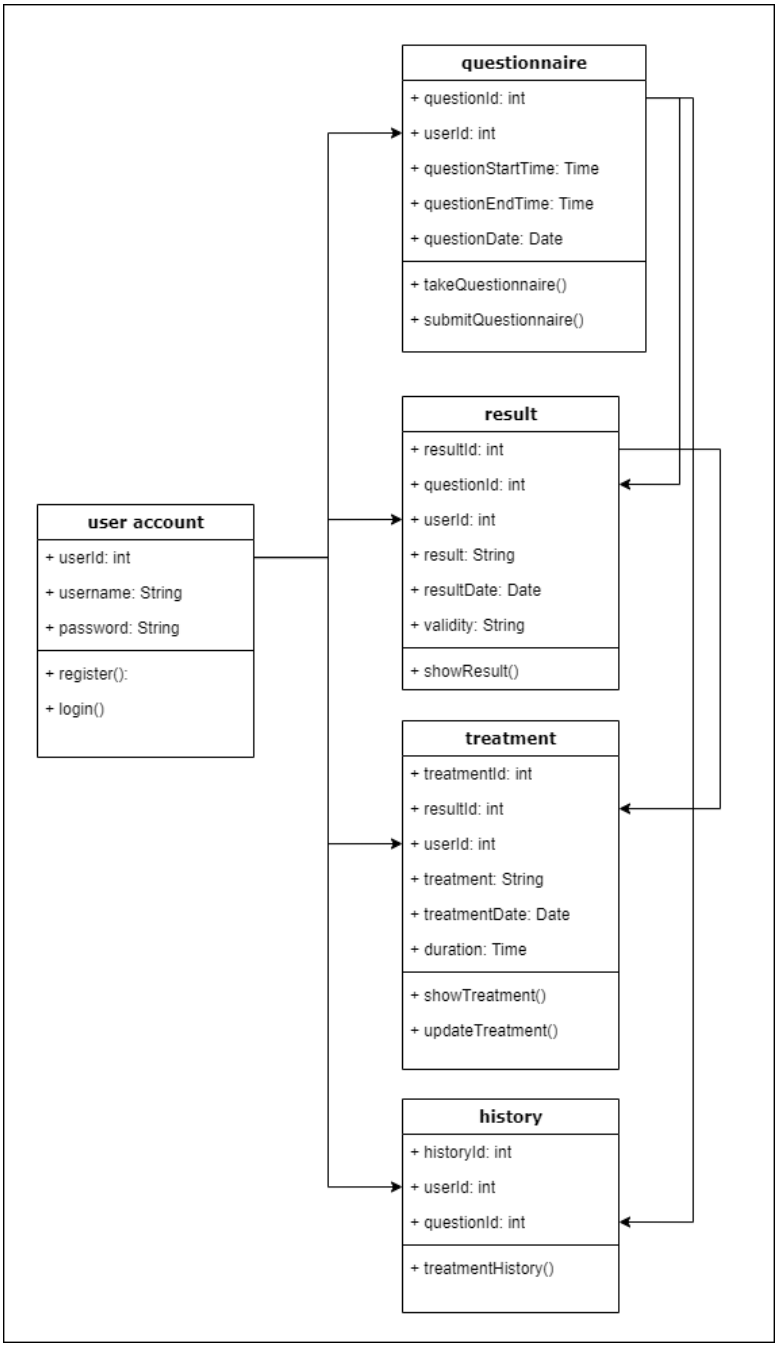

Figure 3. 5 Class Diagram

There are several classes in this diagram, which are:

a. User account, which consists of userId, username, and password.
b. Result, which consists of resultId, questionId, userId, result, resultDate, and validity.
c. Questionnaire, which consists of questionId, userId, questionnaireTime, questionnaireStartTime, questionnaireEndTime, and questionnaireDate.
d. History, which consists of historyId, userId, and questionId.

3. Package Diagram

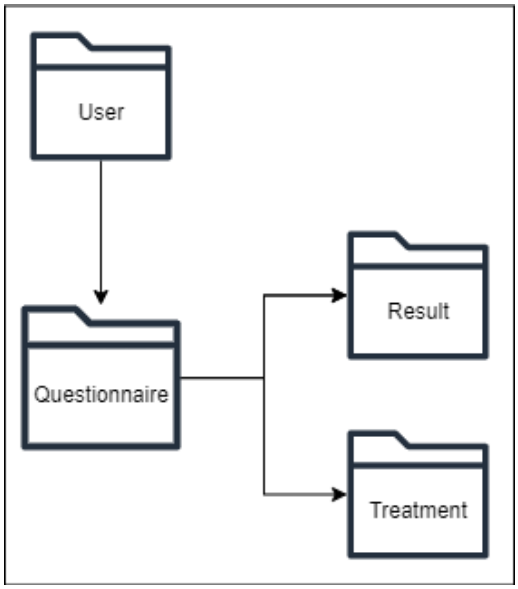

Figure 3. 6 Package Diagram

The package diagram is divided to several packages, which are divided by the flow of the systems:

a. User
b. Result
c. Questionnaire
d. Treatment

4. Collaboration Diagram

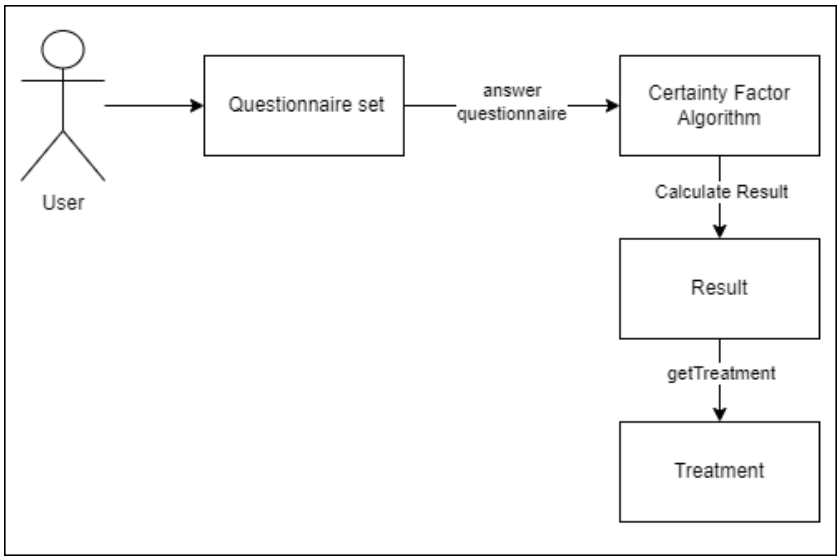

Figure 3. 7 Collaboration Diagram

5. Sequence Diagram

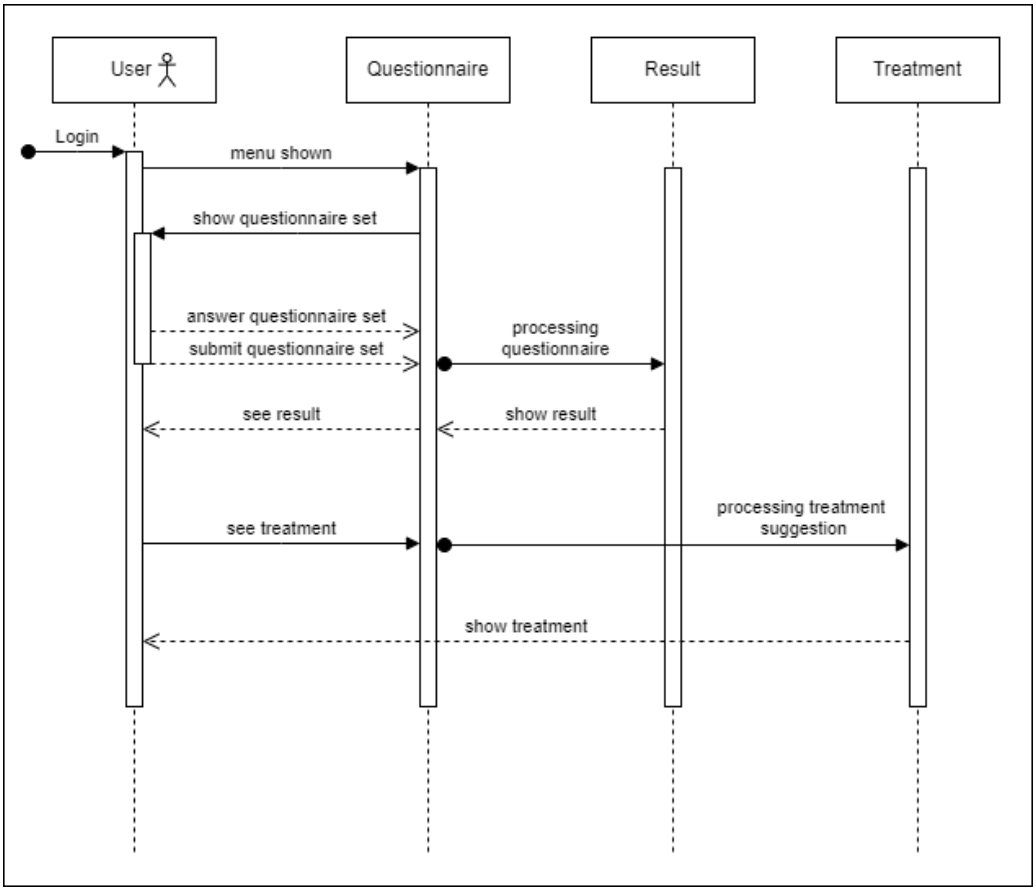

Figure 3. 8 Sequence Diagram

The sequence diagram shows the flow exactly like below:

a. Login, from user. If a login succeeds, they will enter the surface of other segments, such are questionnaire, result, treatment, and consultation.
b. Then the questionnaire data shows questionnaire set, where it is continued to the user to be answered and submitted
c. The questionnaire set will process the answers to the result segment, then it will be returned to the user, whereas user can see the result.
d. If the user wants to see the treatment, then the request will be delivered to the treatment segment. The request will then be returned to be shown to the user

6. State Machine Diagram

a. Login/Register

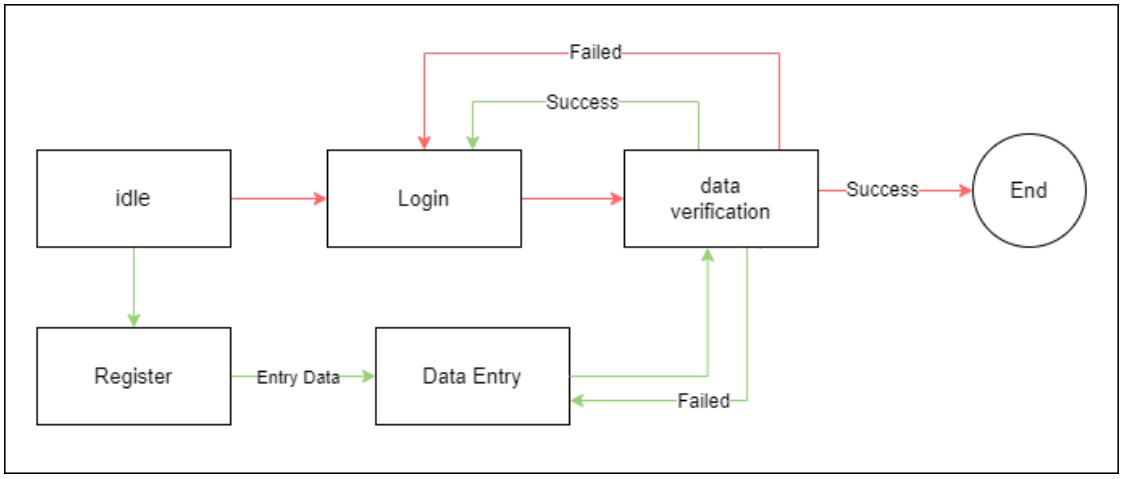

Figure 3. 9 State Machine Diagram; Login/Register

The flow of this diagram is almost similar to the activity diagram. What differs is that this diagram is shown through the point of view of a machine. Instead of start, it is said that the initial condition of the system is idle, meaning that there is no activity at all. Then, if a user does login to the application, the system will verify the login data with the database, and accept the login activity. This goes the same to the register activity.

b. Questionnaire, Result, and Treatment

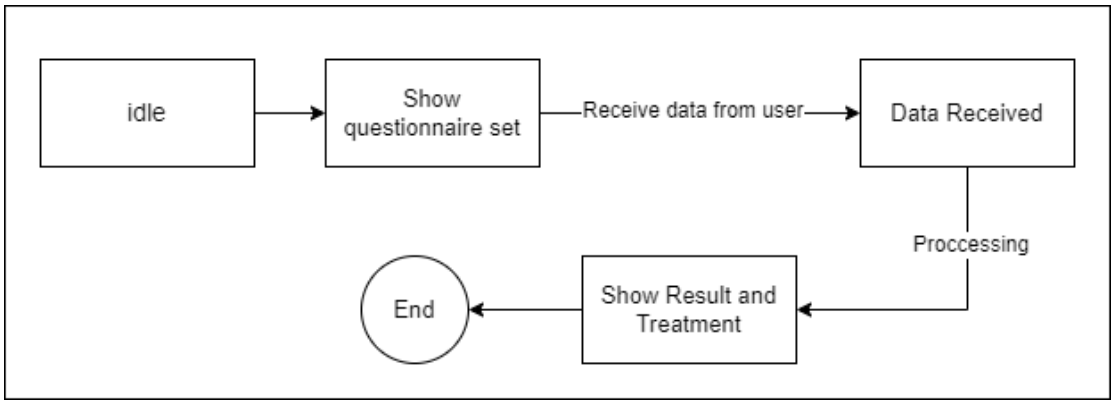

Figure 3. 10 State Machine Diagram; Questionnaire, Result, and Treatment

As point A mentioned, this is shown in the point of view of machine, so the initial position must be idle. If the system has show questionnaire set and receives the data from user, the system will process the answer by using certainty factor algorithm, then show the result to the user.

7. Activity Diagram

a. Login/Register

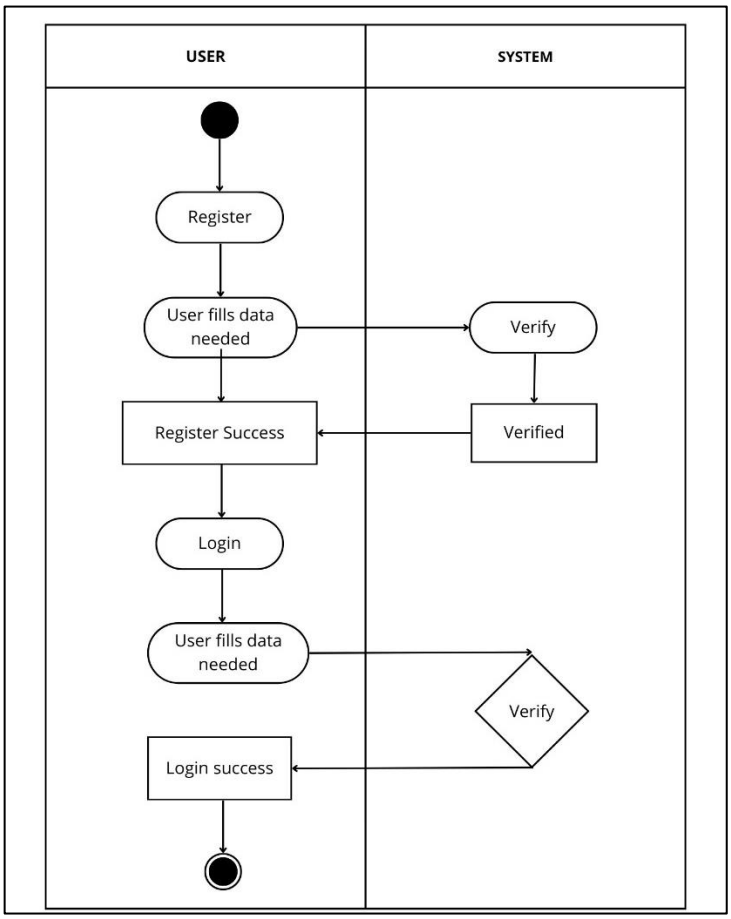

Figure 3. 11 Activity Diagram; Login/Register

This diagram shows the activity when a user wants to login/register to the system, which the flow explained below:

a. User who has no account register and fills the data needed by the system, such as name, username, and password. If the user has sent the data, the system then will verify and process the data. If the data is valid, then the user would be directed to login activity. Otherwise, the user would need to re-do the register activity again.
b. If the user has entered the login activity, the user will also need to fill the data needed by the system. If the data is verified and recognized by the system, the data will be accepted and the login would be successful. Otherwise, the user will need to re-do the login activity.

b. Questionnaire

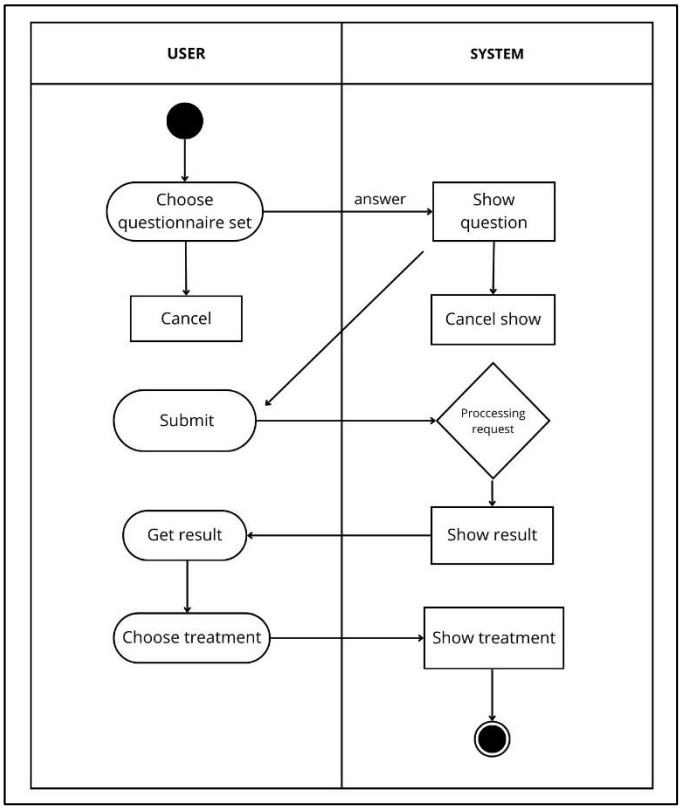

Figure 3. 12 Activity Diagram Questionnaire

This diagram shows the flow like below:

a. Start of the diagram is when the user chooses a questionnaire set. If the user decides to cancel the request, the system will end/terminated. However, if the user chooses to continue, the system will show the question set, and the user needs to answer it.
b. If the questionnaire is answered, the next step is to submit the questionnaire, which later will be processed by the system. The system then will show result that will be gotten by the user.
c. After a result is shown, the user can request to see any treatment provided, and the system will also show the treatment progress also.
d. The end of the system is when the user can exactly see how their treatment is going to be.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter describes the implementation of all information findings collected through the research methodology carried out, the data is checked to see the fulfilment of the desired application criteria. This chapter also shows system testing which will show how the system can run properly. As well as in this chapter identifying and ensuring that the system does not experience errors and the background of the data in the project.

4.2 System Development and Result

4.2.1 Data Collection and Data Preprocessing

The data collected in this step are the data of symptoms from a professional psychologist. This data consists of many key components for creating Database Detection System, including the symptoms of four kinds of eating disorder. The data then is thoroughly cleaned and organized to create a more sufficient data to be processed. The data is shown below with P1 as Anorexia Nervosa, P2 as Bulimia Nervosa, P3 as Binge Eating Disorder, and P4 ARFID:

Table 4. 1 The MB and MD Score for Each Disorder

Symptoms	Disease							
	P1		P2		P3		P4	
	MB	MD	MB	MD	MB	MD	MB	MD
G01	0.9	0.01						
G02	0.5	0.05						
G03	0.5	0.05						
G04	0.5	0.01						
G05	0.8	0.01						
G06	0.9	0.01						
G07	0.9	0.01						

G08	0.9	0.01						
G09	0.9	0.01						
G10	0.8	0.01						
G11			0.9	0.01				
G12			0.9	0.01				
G13			0.6	0.01				
G14			0.9	0.01				
G15			0.9	0.01				
G16			0.9	0.01				
G17			0.6	0.01				
G18			0.6	0.01				
G19			0.5	0.05				
G20			0.5	0.05				
G21					0.9	0.05		
G22					0.8	0.01		
G23					0.9	0.05		
G24					0.9	0.05		
G25					0.8	0.01		
G26					0.9	0.05		
G27					0.9	0.05		
G28					0.6	0.01		
G29					0.8	0.01		
G30					0.9	0.05		
G31							0.9	0.01
G32							0.9	0.01
G33							0.6	0.05
G34							0.6	0.05
G35							0.9	0.05
G36							0.9	0.01

These results are read as the direction below:

Table 4. 2 The Directions of The MB and MD

Belief	MB/MD
Uncertain	0 – 0,29
Maybe	0,3 – 0,49
Possible	0,5 – 0,69
Almost Certain	0,7 – 0,89
Certain	0,9 – 1,0

4.2.2 Model Selection

The model selection, the step after finishing data collection, is a step to create the module of the function, which is the Certainty Factor function, formulated as below:

a. Single Certainty Factor:

$$CF\ (H|E) = MB\ (H|E) - MD\ (H|E)$$

The following formula details are below:

1. CF is the certainty factor symbol
2. $MB\ (H|E)$ and $MD\ (H|E)$ is the measure of belief in hypothesis H given evidence E and the measure of disbelief in hypothesis H given evidence E.

b. Combined Certainty Factor:

- If $CF1$ and $CF2$ are positive supporting evidence

$$CFcombined\ = CF1 + CF2\ x\ (\ 1 - CF1)$$

- If $CF1$ and $CF2$ are negative conflicting evidence

$$CFcombined\ = CF1 + CF2\ x\ (\ 1 +\ CF1)$$

The following formula details are below:

1. CF is the certainty factor symbol

4.2.3 Data Training and Data Testing

After the model is selected, the model then is trained by using the symptoms data to create an accurate system of the model. Here are some the training data and testing data. The manual training, before implying it to the code, looks like below:

1. Given several symptoms of general eating disorders.

Table 4. 3 The Example of The Symptoms

G04	Reluctant to eat in public
G10	Tends to lie about how much food has been consumed
G11	Very concerned with weight and body shape

2. Calculate the CF for each symptom:
    a. G04
        i. $mbG04 = 0.5$
        ii. $mdG04 = 0.1$
        iii. $CFG04 = mbG04 - mdG04 = 0.5 - 01 = 0.4$
    b. G10
        i. $mbG10 = 0.8$
        ii. $mdG10 = 0.1$
        iii. $CFG10 = mbG10 - mdG10 = 0.8 - 01 = 0.7$
    c. G11
        i. $mbG11 = 0.9$
        ii. $mdG11 = 0.1$
        iii. $CFG11 = mbG11 - mdG11 = 0.9 - 0.1 = 0.8$
3. Combine all the CF
    a. CFG04 + CFG10
        i. $CFcombined1 = CFG04 + CFG10\ x\ (1 - CFG04)$
        ii. $CFcombined1 = 0.4 + 0.7\ x\ (1 - 0.4)$
        iii. $CFcombined1 = 0.4 + 0.7\ x\ 0.6 = 0.82$
    b. CFG0410 + CFG11
        i. $CFcombined1 = CFG0410 + CFG11\ x\ (1 - CFG0410)$
        ii. $CFcombined1 = 0.82 + 0.8\ x\ (1 - 0.82)$

iii. $CFcombined1 = 0.82 + 0.8\ x\ 0.18 = 0.964$

The result shows the number of 0.964, meaning the diagnosis is currently very high for the eating disorder. To further enhance the disease, a more complicated CF is development, shown in the sub-chapter of 4.2.4.

4.2.4 Website Development and Result

As the model is completed trained, the next thing to do is to create a website to apply the model in it. In this study, the website is developed with the programming language of CSS and PHP, in which broken down into these parts of feature:

1. Sign in, the feature of user signing in using the account that has been registered in the register feature.

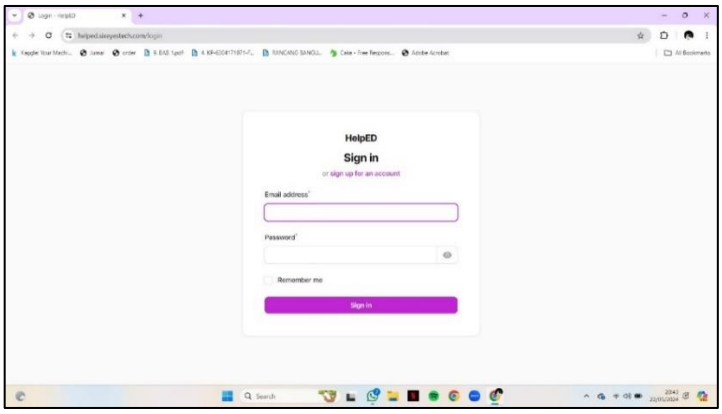

Figure 4. 1 Interface of Sign In in HelpED

2. Register, the feature where the user can register their account to access the website of 'HelpEd', consisting of name, email address, gender, age, and password.

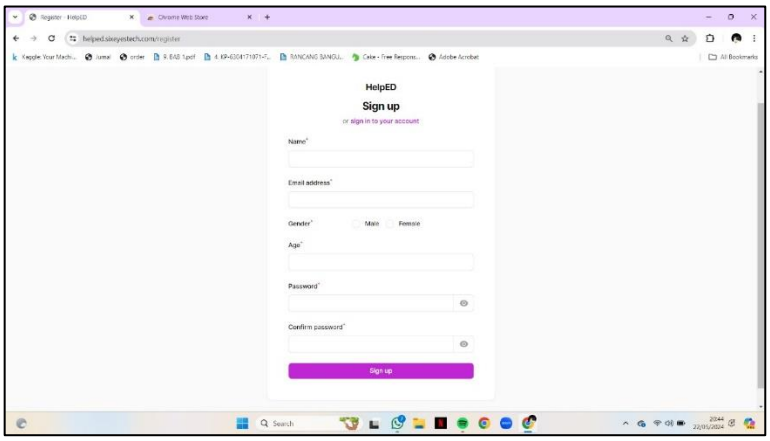

Figure 4. 2 Interface of Register in HelpED

3. Dashboard, the first interface shown after the user logins in. It contains the article previews and the other menus of the website.

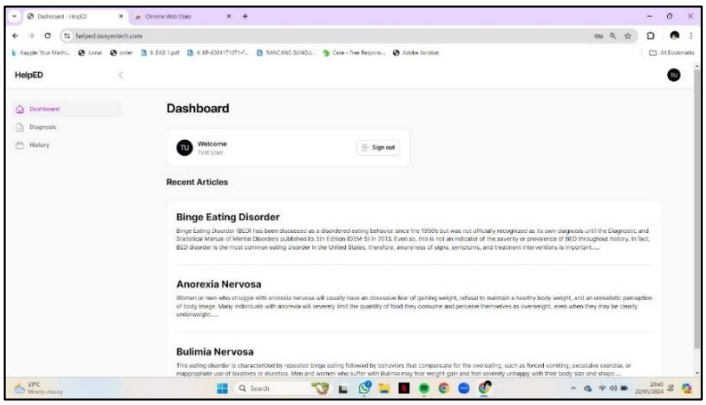

Figure 4. 3 Interface of Dashboard in HelpED

4. Diagnosis, the feature where the user can take the questionnaire that is affected by the module of certainty factor. The questionnaire consists of multiple-choice questions.

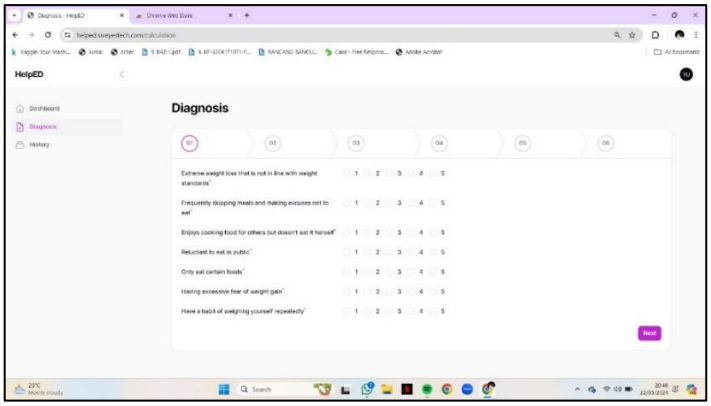

Figure 4. 4 Interface of Diagnosis in HelpED

5. History, where the user can check the frequency they answered the questionnaire and got the results.

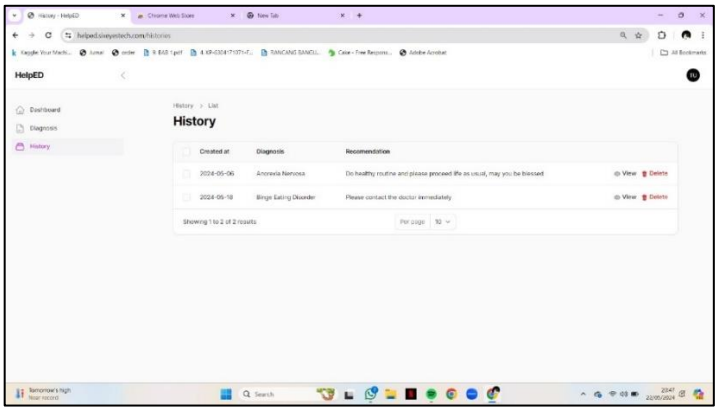

Figure 4. 5 Interface of History in HelpED

6. Article, the interface containing several articles related to information with eating disorder, equipped with direct links to the official journal.

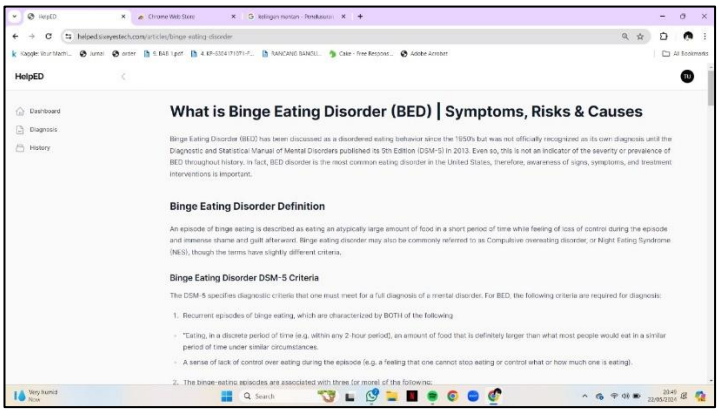

Figure 4. 6 Interface of Article in HelpED

7. Profile, the basic feature where the user can see and edit their current information to an updated one.

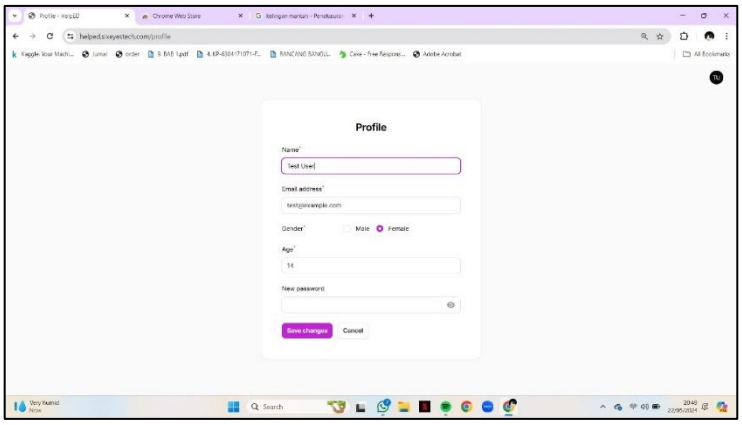

Figure 4. 7 Interface of Profile in HelpED

4.2.5 User Testing

To enhance the performance of the website, the next thing done after developing the application is to give a survey of testing to the respondents, with the testing case such as below:

Table 4. 4 User Testing of HelpED

Num	Feature	Objective	Expected Result
1	Register interface	To test that user can register to the system and the data recorded to database	After successful, validation the user will be redirected to the homepage

2	Login Interface	To test the user can login by email and password already registered	After the login button is pressed, you can successfully enter the main page and there will be an alert if you enter the wrong email or password.
3	Profile Interface	To test it, users can add personal information data to the system and record data to the database	After successful validation, the data will be saved into the database
4	Dashboard Interface	To display various information about eating disorders	Users can view various information about eating disorders
5	Questionnaire Interface	To collect data and determine the diagnosis	Users can fill out a questionnaire to determine the diagnosis
6	History Interface	To show the diagnosis history	Users can view the history of previous diagnoses

4.2.6 Performance Evaluation

The performance evaluation is the overall testing from the respondents, earning high response of reliability and usability, with results described in the table below:

Table 4. 5 Performance Evaluation of HelpED

Num	Feature	Objective	Expected Result	Status
1	Register interface	To test that user can register to the system and the data recorded to database	After successfull validation the user will be redirected to the homepage	PASS
2	Login Interface	To test the user can login by email and password already registered	After the login button is pressed, you can successfully enter the main page and there will be an alert if you enter the wrong email or password.	PASS
3	Profile Interface	To test it, users can add personal information data to the system and record data to the database	After successful validation, the data will be saved into the database	
4	Dashboard Interface	To display various information about eating disorders	Users can view various information about eating disorders	PASS
5	Questionnaire Interface	To collect data and determine the diagnosis	Users can fill out a questionnaire to determine the diagnosis	PASS
6	History Interface	To show the diagnosis history	Users can view the history of previous diagnoses	PASS

CHAPTER 5

CONCLUSION

5.1 Conclusion

Based on the objectives that has been met, it can be concluded that the research of "Development of Expert System for Diagnosing the Unusual Behaviour of Multiple Categories of Eating Disorder Patients in Gen Z Using Certainty Factor Method", namely HelpED, has several results proven, which are:

1. The expert system of diagnosing Eating Disorder Patients in Gen Z has been made, and effectively diagnoses various eating disorders by using a comprehensive knowledge base and the algorithm of certainty factors.
2. The expert system is successfully creating treatment recommendation based on eating disorder category that has been listed, which are Binge Eating Disorder, Bulimia Nervosa, ARFID, and Anorexia Nervosa. By using the certainty method, the system has built the result shown as three categories, which are: 1) Safe, 2) Yellow Zone (wariness state), and 3) Unsafe (immediate checked to psychologist).
3. The expert system has successfully created the feature of tracking the patient's improvement based on the activity of the user. By using the zone that has been shown in point 2, the moment the user takes the questionnaire again, the system can recognize the percentage of the habit has gone from the user.

5.2 Recommendation

Based on the results of the year's project, there are several things that can be added to make the HelpED system more attractive as follows:

1. To create a more interesting interface, as the interface shown in this research can be considered basic and a bit boring to see.
2. To experiment with different varieties of algorithms, not only having certainty factor as its main formula. This method can be used to create a more accurate result in the future.

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APPENDIX 1

MANUSCRIPT

Development of Expert System for Diagnosing The Unusual Behaviour if Multiple Categories of Eating Disorder in Gen Z Using Certainty Factor Method

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***Abstract*— The increasing prevalence of eating disorders among Generation Z necessitates advanced diagnostic tools to identify and address these issues effectively. This research focuses on the development of an expert system that leverages the Certainty Factor method to diagnose unusual behavior across multiple categories of eating disorders specifically within the Gen Z demographic. The system aims to enhance early detection and provide accurate diagnoses by incorporating a wide range of symptoms and behavioral indicators. The Certainty Factor method allows for handling uncertainty and partial truths, making the system robust and reliable. Preliminary results indicate that the expert system significantly improves diagnostic accuracy compared to traditional methods, offering a valuable tool for healthcare providers in managing and treating eating disorders among young individuals.**

Keywords—certainty factor, eating disorder, gen z.

I. INTRODUCTION

Expert systems have played an important role in medicine. Rather than solely relying on medical doctors, expert diagnostics systems are now being developed to diagnose these diseases and offer expert advice to the patients. These diagnostic systems are being used in medical centers and clinics while some are open source for use by anyone. Expert diagnostics systems aren't developed to eliminate the need for doctors but can even assist the doctors or medical personnel in making faster and reliable diagnosis. It could also be of great use to patients who live in areas where access to doctor is limited and very expensive [1].

The number of patients with eating disorders has been increasing globally for the past 50 years. Since the 1980s, there has been an increase in the prevalence of eating disorders in the Asian population. More recently, there has been an increase in this phenomenon among young women in Singapore. In Singapore, the prevalence of young women at risk for eating disorders is as high as 7.4%. One media outlet in Singapore, in 2007, reported a six-fold increase in teenagers with eating disorders since 2002. Singapore General Hospital reports as many as 140 cases of eating disorders each year, but only 10 to 20% seek treatment. 0.05% of psychiatric patients in Malaysia had been diagnosed with AN, and this figure did not increase for 15 years [2]. In Indonesia, 12-22% of women aged 15-29 suffer from chronic energy deficiency (BMI <18.5) in some areas (Atmarita, 2005). Surprisingly, Indonesia ranks 4th in the world below the USA, India, and China [3]. To address these challenges, the goal is to use information technology by designing a web-based expert system for diagnosing unusual behaviors across multiple categories of eating disorders using the Certainty Factor method. This system aims to make it easier for individuals to recognize symptoms and types of eating disorders without needing to visit a doctor directly. Additionally, it provides solutions to help prevent the onset of eating disorders.

II. LITERATURE REVIEW

A. Key Term Terminology

- Expert system : Intelligent systems is the science dealing with the creation of intelligent machines. An intillegent machine can be interpreted as a machine that can do certain things that require intelligence when done by humans. An expert system or an intelligent system designation by applying several methods, will produce a system that can provide the best solution recommendations. Expert systems also have many methods and algorithms that are adapted to various cases [4],
- Eating disorder : Eating disorder is a symptom of abnormal eating patterns. Eating disorder is defined as a disorder that occurs in eating habits a person that is caused by concern of the person. There are three types of eating disorders according to DSM-5 (Diagnostic and Statistical Manual Of Mental Disorder, 2014) namely : Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder [5]
- Certainty factor : Certainty Factor is a method that defines a measure of certainty for facts or rules to describe an expert's belief in the problem at hand. Certainty Factor shows the measure of certainty of a fact or rule [6].
- Generation z : Generation Z is the generation born between 1995 and 2010. Some of them are entering the developmental phase of adolescence and early adulthood [7]

B. Review of Practical Research

Silicosis Expert System Diagnosis and Treatment" The research paper discusses the development of an expert system for diagnosing silicosis. The expert system incorporates a knowledge base and a set of rules to diagnose the disease based on symptoms. The system uses SL5 Object language and has been evaluated by specialists in lung diseases, with highly satisfactory results. The paper also discusses the use of similar expert systems for diagnosing various diseases, highlighting the importance of accurate diagnosis and treatment. The expert system is user-friendly and does not require intensive training to use, making it a valuable tool for both patients and healthcare providers. Overall, the paper presents the development and evaluation of an expert system for diagnosing silicosis and highlights its potential to improve the accuracy and efficiency of disease diagnosis and treatment [8].

"Anemia Expert System Diagnosis Using Sl5 Object" The paper discusses anemia and the classification of its types based on causes, morphology of red blood cells, and clinical manifestations. It introduces an expert system utilizing artificial intelligence to diagnose five anemia diseases across various stages of life and describes the knowledge base and inference engine of such a system. Additionally, the paper highlights the lack of specialized expert systems for anemia, detailing the main symptoms of the condition. It emphasizes the need for a simple and accessible diagnostic system and the potential for future expansion to include more anemia diseases. The system aims to aid physicians in diagnosing anemia and is developed using SL5 language [9].

"Lower Back Pain Expert System Diagnosis And Treatment" The paper presents the development of an expert system using SL5 Object language, which includes a user interface, explanation subsystem, knowledge base, and inference engine. The system is designed to ask users yes/no questions and provides a diagnosis and recommendation based on the input. The knowledge for the expert system was sourced from physicians and specialized websites for lower back pain, and the system has undergone preliminary testing with positive feedback from medical students [10].

C. Products or Systems

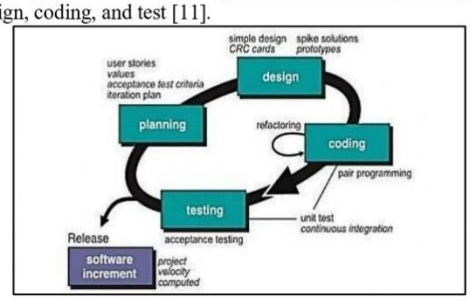
Features	Medscape	EDT	EAT-26	Proposed System
Login	**Yes** Have login on first time using the app for users	**No** Don't have login on first time using the app for users	**No** Don't have login on first time using the app for users	**Yes** Have login on first time using the app for users
Register	**No** If user do not have an account they cannot register it first	**No** If user do not have an account they canoot register it first	**Yes** If user do not have an account they can register it first	**Yes** If user do not have an account they can register it first
Questionnaire set	**Yes** Have a questionnaire set to collect data and determine the diagnosis	**Yes** Have a questionnaire set to collect data and determine the diagnosis	**Yes** Have a questionnaire set to collect data and determine the diagnosis	**Yes** Have a questionnaire set to collect data and determine the diagnosis
Diagnosis result	**Yes** Will show the diagnosis result after fill up the questionnaire set	**Yes** Will show the diagnosis result after fill up the questionnaire set	**Yes** Will show the diagnosis result after fill up the questionnaire set	**Yes** Will show the diagnosis result after fill up the questionnaire set
Treatment	**No** Not display treatment suggestions according to the diagnosis results	**Yes** Will display treatment suggestions according to the diagnosis results	**No** Not display treatment suggestions according to the diagnosis results	**Yes** Will display treatment suggestions according to the diagnosis results
History	**No** Not show the diagnosis history	**Yes** Will show the diagnosis history	**No** Not show the diagnosis history	**Yes** Will show the diagnosis history
Logout	**Yes** Have log out to leave the app	**No** Don't have log out to leave the app	**No** Don't have log out to leave the app	**Yes** Have log out to leave the app

Figure. 1 Comparison of System

III. METHODOLOGY

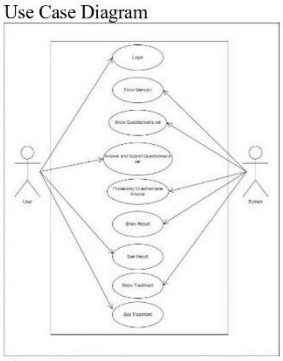
A. Agilel Software Development Life Cycle

In this project will be using a project management called Extreme Programming. Extreme programming is one of the development methods derived from agile development. Extreme Programming (XP) is a software engineering development method that targets teams formed on a small to medium scale, and this method can also be used for system development with unclear requirements or changes to requirements very quickly. XP is a method that has a good level of responsiveness to change. The advantages of the XP method also offer stages in a short processing time in accordance with the focus to be achieved. The stages of software development with XP are: planning, design, coding, and test [11].

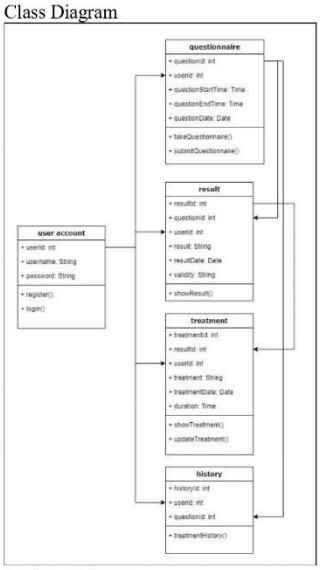


B. UML Modeling of The Proposed System

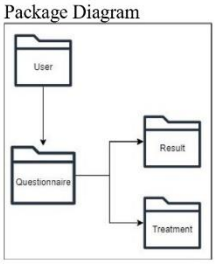
- Use Case Diagram



- Class Diagram



- Package Diagram



IV. ANALYSIS AND DISCUSSION

A. Data Collection

The first thing needs to do in developing the system is to search for any data set that is previously created to match with the data collection. In this study, the data set comes from the website of Coco is looking like the picture down below: The data collected in this step are the data of symptoms from a professional psychologist. This data consists of many key components for creating Database Detection System, including the symptoms of four kinds of eating disorder. The data then is thoroughly cleaned and organized to create a more sufficient data to be processed. The data is shown below with P1 as Anorexia Nervosa, P2 as Bulimia Nervosa, P3 as Binge Eating Disorder, and P4 ARFID:

Symptoms	Disease							
	P1		P2		P3		P4	
	MB	MD	MB	MD	MB	MD	MB	MD
G01	0.9	0.01						
G02	0.5	0.05						
G03	0.5	0.05						
G04	0.5	0.01						
G05	0.8	0.01						
G06	0.9	0.01						
G07	0.9	0.01						
G08	0.9	0.01						
G09	0.9	0.01						
G10	0.8	0.01						
G11			0.9	0.01				
G12			0.9	0.01				
G13			0.6	0.01				
G14			0.9	0.01				
G15			0.9	0.01				
G16			0.9	0.01				
G17			0.6	0.01				
G18			0.6	0.01				
G19			0.5	0.05				
G20			0.5	0.05				
G21					0.9	0.05		
G22					0.8	0.01		
G23					0.9	0.05		
G24					0.9	0.05		
G25					0.8	0.01		
G26					0.9	0.05		
G27					0.9	0.05		
G28					0.6	0.01		
G29					0.8	0.01		
G30					0.9	0.05		
G31							0.9	0.01
G32							0.9	0.01
G33							0.6	0.05
G34							0.6	0.05
G35							0.9	0.05
G36							0.9	0.01

Figure 3. Datasets

B. Certainty Factor

- Single Certainty Factor:

$$CF\,(H|E) = MB\,(H|E) - MD\,(H|E)$$

The following formula details are below:

1. CF is the certainty factor symbol
2. $MB\,(H|E)$ and $MD\,(H|E)$ is the measure of belief in hypothesis H given evidence E and the measure of disbelief in hypothesis H given evidence E.

- Combined Certainty Factor:

1. If $CF1$ and $CF2$ are positive supporting evidence

$$CFcombined = CF1 + CF2\,x\,(1 - CF1)$$

2. If $CF1$ and $CF2$ are negative conflicting evidence

$$CFcombined = CF1 + CF2\,x\,(1 + CF1)$$

The following formula details are below:

1. CF is the certainty factor symbol

C. System Result

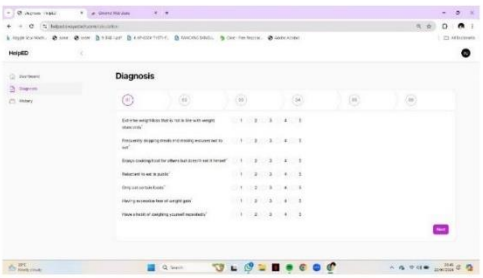


Figure 5 Result

V. CONCLUSION

The activity carried out is to create a system for Diagnosing the Unusual Behavior of Multiple Categories of Eating Disorder Patients, namely HelpED, so that several things can be concluded as follows:

1. HelpED system is built to help users who have eating disorder problems, starting from information about eating disorders and types of eating disorders. Users can access features quickly, easily and practically with. The most dominant feature in this application is the "Diagnosis" feature where users only need to select the symptoms experienced and then users will know the results of the diagnosis along with the appropriate prevention or treatment. With the creation of this system, it is hoped that it can help users in diagnosing eating disorder.
2. Application of the Certainty Factor method in Expert Systems to diagnose eating disorder with the same calculation results or weights as manual calculations.
3. The application of the Certainty Factor method uses the MB (Measure of Belief) and MD (Measure of Disbelief) values of a symptom determined by an expert and then calculated using the Certainty Factor formula according to the symptoms selected by the user.

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APPENDIX 2

EXTENDED ABSTRACT

MSU Idea Regeneration Expo 2024 (iREX17)

Development of Expert System for Diagnosing The Unusual Behaviour of Multiple Categories of Eating Disorder in Gen Z Using Certainty Factor Method

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ABSTRACT

The increasing prevalence of eating disorders among Generation Z necessitates advanced diagnostic tools to identify and address these issues effectively. This research focuses on the development of an expert system that leverages the Certainty Factor method to diagnose unusual behavior across multiple categories of eating disorders specifically within the Gen Z demographic. The system aims to enhance early detection and provide accurate diagnoses by incorporating a wide range of symptoms and behavioral indicators. The Certainty Factor method allows for handling uncertainty and partial truths, making the system robust and reliable. Preliminary results indicate that the expert system significantly improves diagnostic accuracy compared to traditional methods, offering a valuable tool for healthcare providers in managing and treating eating disorders among young individuals.

Keywords: certainty factor, eating disorder, gen z, expert system

INTRODUCTION

Expert systems have played an important role in medicine. Rather than solely relying on medical doctors, expert diagnostics systems are now being developed to diagnose these diseases and offer expert advice to the patients. These diagnostic systems are being used in medical centers and clinics while some are open source for use by anyone. Expert diagnostics systems aren't developed to eliminate the need for doctors but can even assist the doctors or medical personnel in making faster and reliable diagnosis. It could also be of great use to patients who live in areas where access to doctor is limited and very expensive [1].

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OBJECTIVES

1. To create an expert system that can be used to diagnose eating disorders.
2. To suggest the treatment based on eating disorder category.
3. To provide tracking on the improvement based on acitivity by the user

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METHODOLOGY

For the project "Development of Arduino Uno-based Tomato Plant Watering and Lighting Automation Using Solar Panels", a suitable software development method is Agile. The Agile method is a collaborative and flexible approach that allows adaptation to changing needs, ensuring fast and quality delivery. [8]

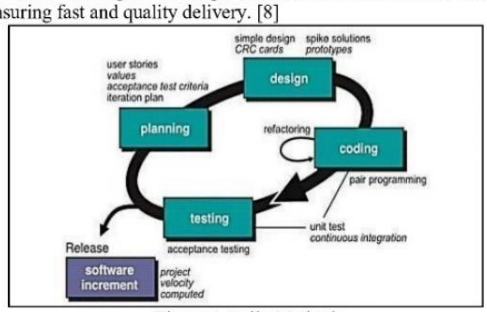

Figure 1 Agile Method

In this project will be using a project management called Extreme Programming. Extreme programming is one of the development methods derived from agile development. Extreme Programming (XP) is a software engineering development method that targets teams formed on a small to medium scale, and this method can also be used for system development with unclear requirements or changes to requirements very quickly. XP is a method that has a good level of responsiveness to change. The advantages of the XP method also offer stages in a short processing time in accordance with the focus to be achieved. The stages of software development with XP are: planning, design, coding, and test [11].

RESULTS AND DISCUSSION

A. Data Collection

The first thing needs to do in developing the system is to search for any data set that is previously created to match with the data collection. In this study, the data set comes from the website of Coco is looking like the picture down below: The data collected in this step are the data of symptoms from a professional psychologist. This data consists of many key components for creating Database Detection System, including the symptoms of four kinds of eating disorder. The data then is thoroughly cleaned and organized to create a more sufficient data to be processed. The data is shown below with P1 as Anorexia Nervosa, P2 as Bulimia Nervosa, P3 as Binge Eating Disorder, and P4 ARFID:

Symptoms	*Disease*							
	P1		*P2*		*P3*		*P4*	
	MB	*MD*	*MB*	*MD*	*MB*	*MD*	*MB*	*MD*
G01	*0.9*	*0.01*						
G02	*0.5*	*0.05*						
G03	*0.5*	*0.05*						
G04	*0.5*	*0.01*						
G05	*0.8*	*0.01*						
G06	*0.9*	*0.01*						
G07	*0.9*	*0.01*						
G08	*0.9*	*0.01*						
G09	*0.9*	*0.01*						
G10	*0.8*	*0.01*						
G11			*0.9*	*0.01*				
G12			*0.9*	*0.01*				
G13			*0.6*	*0.01*				
G14			*0.9*	*0.01*				
G15			*0.9*	*0.01*				
G16			*0.9*	*0.01*				
G17			*0.6*	*0.01*				
G18			*0.6*	*0.01*				
G19			*0.5*	*0.05*				

G20			*0.5*	*0.05*				
G21					*0.9*	*0.05*		
G22					*0.8*	*0.01*		
G23					*0.9*	*0.05*		
G24					*0.9*	*0.05*		
G25					*0.8*	*0.01*		
G26					*0.9*	*0.05*		
G27					*0.9*	*0.05*		
G28					*0.6*	*0.01*		
G29					*0.8*	*0.01*		
G30					*0.9*	*0.05*		
G31							*0.9*	*0.01*
G32							*0.9*	*0.01*
G33							*0.6*	*0.05*
G34							*0.6*	*0.05*
G35							*0.9*	*0.05*
G36							*0.9*	*0.01*

Figure 3. Datasets

Certainty Factor

- *Single Certainty Factor:*

$$CF\,(H|E) = MB\,(H|E) - MD\,(H|E)$$

The following formula details are below:

1. CF *is the certainty factor symbol*
2. $MB\,(H|E)$ *and* $MD\,(H|E)$ *is the measure of belief in hypothesis H given evidence E and the measure of disbelief in hypothesis II given evidence E.*

- *Combined Certainty Factor:*
  1. *If* $CF1$ *and* $CF2$ *are positive supporting evidence*

$$CFcombined = CF1 + CF2\,x\,(1 - CF1)$$

  2. *If* $CF1$ *and* $CF2$ *are negative conflicting evidence*

$$CFcombined = CF1 + CF2\,x\,(1 + CF1)$$

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CONCLUSIONS

The activity carried out is to create a system for Diagnosing the Unusual Behavior of Multiple Categories of Eating Disorder Patients, namely HelpED, so that several things can be concluded as follows:

1. HelpED system is built to help users who have eating disorder problems, starting from information about eating disorders and types of eating disorders. Users can access features quickly, easily and practically with. The most dominant feature in this application is the "Diagnosis" feature where users only need to select the symptoms experienced and then users will know the results of the diagnosis along with the appropriate prevention or treatment. With the creation of this system, it is hoped that it can help users in diagnosing eating disorder.
2. Application of the Certainty Factor method in Expert Systems to diagnose eating disorder with the same calculation results or weights as manual calculations.
3. The application of the Certainty Factor method uses the MB (Measure of Belief) and MD (Measure of Disbelief) values of a symptom determined by an expert and then calculated using the Certainty Factor formula according to the symptoms selected by the user.

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APPENDIX 3

POSTER