Body weight anthropometry expert system for disease diagnosis

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Abstract. Human body measurements or anthropometry are carried out, among others, to meet industrial and health needs. Products that will be used by humans need to use anthropometry to suit the people who use them. The use of anthropometry in health, among others, is used as an indicator of health as well as a person nutritional level. The measure that is widely used for the criteria for human health is weight. Based on body weight can be determined the level of health and the possibility of a disease suffered by a person. Knowledge of weight anthropometry is packaged in the form of an expert system so that it can be used for consultation by people who have health problems based on body weight. The methodology used in this design uses Expert System Development Life Cycle, as well as knowledge representation techniques use artificial intelligence production systems. The design results are dynamic software, which is able to overcome diseases based on body weight data. Disease is divided into two categories, namely diseases based on high body weight and low body weight. Expert System has been validated by an expert. The validation results describe the expert system can provide solutions that are in accordance with the knowledge provided. The resulting system can be run by lay people in the training process for 2 hours. The conclusions from this study are that expert systems are able to be applied to assist humans in introducing effective and efficient weight-based anthropometric diseases. The artificial intelligence production system provides a knowledge base, rule base, and control strategies for finding weight anthropometric solutions.

1. Introduction
Body weight is a factor that can indicate a person's health. People who have excess weight or are very less at risk of disease are higher than those who have a normal body weight. Detection of disease based on anthropometry weight is usually carried out by health workers, especially a doctor [1]. Special circulation of a doctor, makes doctors become scarce, because it needs technology that can duplicate this knowledge in order to serve more patients. Alternatives to addressing these needs can use expert systems. An expert system is a system that seeks to adopt and acquire human knowledge into a computer, so that the computer can handle problems commonly carried out by experts. A good expert system is designed to solve problems by matching the work patterns of experts. Expert systems have been used to imitate experts in various fields including health, maintenance of equipment, agricultural counselling, and religion [2]. In line with the development of expert systems, doctors' knowledge in determining diseases based on anthropometric weight can be replicated and reproduced, in order to serve more patients in various places. Doctors can use the expert system in carrying out their duties, among others, in storing knowledge about the patient's body weight data and the disease suffered by the patient. The
relationship between the weight of the patient and the disease suffered is arranged in a knowledge base, followed by a solution to overcome the disease suffered [3]. The expert system built with the system builder is validated by the doctor concerned, in order to be able to represent the workings of the doctor. Based on this, the study aims to design an expert system capable of identifying disease based on anthropometric weight.

2. Methodology

As a software, expert systems are built using software development methods. Software development methods that are widely used include rapid application development [4] and prototyping [5]. Another method that is widely used is the Sequential Development Life Cycle (SDLC) method, in which the multimedia system design method is modified into the Multimedia Development Life Cycle method [6]. The design of this expert system uses the SDLC method which is modified to build an expert system known as the Expert System Development Life Cycle (ESDLC) method [7]. The Expert Method System Development Life Cycle (ESDLC) includes six stages, namely the stages of Assessment, Knowledge Acquisition, Design, and Test. The assessment phase is the initial stage to see the feasibility of making expert systems in terms of technology, expert availability, and the level of need for experts. The stage of knowledge acquisition is the stage of gathering knowledge to build an expert system. The design phase is the stage for designing and building knowledge and systems. Finally, the testing phase is the stage to test system functions and the suitability of system knowledge with expert knowledge [8]. The ESDLC method stages in building expert anthropometric systems of weight are described using the Work Breakdown Structure (WBS) limited to the testing phase as shown in Figure 1.

![Figure 1. WBS of weight loss anthropometry expert system design.](image)

The four stages of ESDLC used in this study are described as smaller stages. The assessment phase consists of the stages of problems feasibility and justification, and need assessment. The stage of knowledge acquisition consists of sources of knowledge and elicitation of knowledge. The design phase consists of the stages of knowledge representation, user interface, and construction. The testing phase consists of functional and validation tests.
3. Result and discussion

3.1. Assessment
Activities carried out at this stage of the assessment are: determining the feasibility of the problem and its justification, determining the needs analysis and determining the source of knowledge [9].

3.1.1. Problem feasibility and justification. Life in the city which is marked by busyness in the office can change lifestyle and diet, from traditional diets to a diet of practical and ready-to-eat foods. Prepared foods generally contain unbalanced nutrition. This increases the risk of weight problems, both low weight and excess weight. Weight problems hide certain diseases, but a health expert can diagnose abnormal weight-based diseases. Such expertise is usually owned by a doctor. The existence of expert system technology allows expert knowledge to be transferred to computers as an expert system. Based on the discussion above, the diagnosis of weight problems in adults is feasible to become an expert system. The source of knowledge can be taken by interviewing experts or using books written by the experts concerned.

3.1.2. Need assessment. The design of this expert system requires several resources including: hardware and software. Today there are hardware and software available that can be used to build expert systems.

3.2. Knowledge acquisition
Knowledge is collected from knowledge sources through an elicitation process. Knowledge Elicitation from human experts is one of the difficulties in developing expert systems. Knowledge Engineers need to look at the conditions of experts when conducting interviews, and the type of knowledge that will be taken needs to be carefully determined to suit the user's needs.

3.2.1. Source of knowledge. The source of knowledge in designing expert systems comes from interviews with an experienced doctor working for a national company. In order for the difficulties in the knowledge elicitation to be reduced, then for a source of knowledge also used a book that contains topics that are in accordance with the expert system that was built.

3.2.2. Elicitation of knowledge. Knowledge of anthropometric-related diseases of body weight was collected and grouped by category, symptoms that appeared, possible causes and actions to be taken in weight problems in adults. The results are arranged and functionally displayed in the tree diagram in Figure 2.

![Figure 2. Tree diagram of adult weight problems.](image-url)
The problem of weight in adults was divided into 2 categories, namely less weight and excess body weight [10,11]. The down weight category has 7 possible causes. While the excess weight category has 10 possible causes.

3.3. Design
Activities carried out at the design stage are: making knowledge representations, compiling knowledge bases, designing rules, designing databases, designing menu structures and interfaces, as well as constructing.

3.3.1. Knowledge representation. Knowledge representation is a way to display knowledge from human experts so that it can be used in expert system programming. Knowledge can be formed into a series of data and rules in finding problem solving or conclusions. The main knowledge representation technique used in this design is an artificial intelligence production system that includes a knowledge base, rule base, and control strategy.

The knowledge base in this design is structured as knowledge in the form of a database. Rule base is a rule that connects data or facts to conclusions. The knowledge base in this design is modelled in the Entity Relationship Diagram, ERD.

![ERD weight loss anthropometry expert system](image)

Figure 3. ERD weight loss anthropometry expert system.

The results of knowledge acquisition in the form of a basic table of weight problems in adults are grouped into 3 namely: basic category tables, symptom base tables and solution tables. Knowledge to diagnose disease based on body weight is illustrated in the frame (Figure 3)

3.3.2. Interface design. The interface is a media interaction between the system and the user. System design is required to design an interface that is effective and easy to understand, so that users can use the system properly.

3.3.3. Construction. Construction is the implementation stage of all stages that have been discussed in the previous stage using the programming language. Programming language used is MySQL for database design and PHP for designing the interface.

3.4. Testing
The testing phase aims to determine the success of the system that has been made, and to ensure the system that is built has good quality in accordance with the initial objectives of the design and has met user requirements. Tests are carried out using the Black Box Test conducted by experts. Testing is done by experts by selecting the category of weight problems, then answering questions about the symptoms that arise by selecting yes and no answers. After the question is answered, the system will bring up a solution by displaying possible causes and actions to be taken.
4. Conclusion
Based on the results of observations and discussions in the previous chapters, and based on the tests that have been conducted, some conclusions can be taken as follows:

- Expert systems for diagnosing weight problems have been successfully built using the traditional ESDLC method.
- The expert system designed to build has a knowledge base that can be updated according to the development of weight anthropometry.
- The development of this system requires the participation of many parties, allowing other knowledge engineers, weight anthropometric health experts, and system builders.
- This expert system was built using a programming language with a web platform so that it can be accessed via the internet.

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