Mobile Expert System for Dengue Fever Based on Certainty Factor Method

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Abstract. The development of information technology more rapidly, it can be used to study the dangers of dengue fever and know the type of symptoms that resemble dengue fever. In this research, the design and implementation of multimedia-based android application in which there are components of text, images, and animation. The purpose of designed and built application "Dengue Alert" to help users learn and do the prevention of dengue fever. Besides this application also provides information how to deal with dengue fever. This application was developed by utilising Certainty Factors method as a method of decision support. The result of this research is a mobile application that 97.6% can predict Dengue Hemorrhagic Fever (DHF) so that DHF can be detected early.

1. Introduction
Dengue hemorrhagic fever (DHF) is a disease caused by a virus from the family Flaviviridae [1]. DHF is transmitted through the bite of Aedes Aegypti [2] and Aedes Albopictus mosquitoes [3][4]. DHF is a leading cause of death in many tropical countries [2]. 2.5% of the 50 million world population infected with the dengue virus die [5]. DHF sufferers in Indonesia tend to increase and expand rapidly so that sometimes cause extraordinary events [6]. from 1968 to 2009 Indonesia ranked first in Southeast Asia as a country with the highest DHF cases [6]. The widespread of DHF in Indonesia is caused by increasing population density and mobility as well as the widespread spread of mosquitoes transmitting DHF [7]. Factors that influence the outbreak of dengue hemorrhagic fever include home, environmental, and viral factors [2]. In the transition climate conditions and changes in the quality of the residential environment, there are several types of diseases that have almost similar symptoms of fever, so laboratory examination is needed [3]. Busyness is one of the reasons why people are reluctant to check themselves if they have a fever, so a mobile application that has the ability of a doctor is needed in diagnosing a disease. So that DHF can be detected early.

This study aims to facilitate the public in obtaining information about dengue fever which includes symptoms of dengue fever, information and prevention of dengue fever, the level of dengue fever suffered, information about transmission and prevention of dengue fever. All information is contained in a mobile application called "Dengue Alert". The Certainty Factor method is embedded in this smart application. The CF method is used because the performance of the system built using CF can run following functional requirements and has a high percentage of accuracy [8]. Besides, the CF method can describe the level of expert confidence in the problem at hand [8][9].
2. Literature Review

2.1. Dengue hemorrhagic fever
Dengue hemorrhagic fever (DHF) is a disease caused by a virus by the family of Flaviviridae [1] and is transmitted by mosquitoes Aedes Aegypti [2] and Aedes Albopictus [1][2]. The incubation period occurs for 4-6 days. People who are bitten by mosquitoes transmitting dengue fever (Aedes - Aegypti) which contain the dengue virus (Dengue Virus) within 1 week can suffer from dengue fever [10].

2.2. Dengue fever and Dengue hemorrhagic fever
The course of viral infectious diseases in the human body is highly dependent on the interaction between immunological conditions and the age of a person [10] [11]. Therefore, dengue virus infection can be asymptomatic or have a mild clinical manifestation that is fever without a clear cause (undifferentiated) febrile illness), dengue fever (DF), and manifests as severe dengue hemorrhagic fever (DHF) without shock or dengue shock syndrome (SSD). DF is acute fever for 2-7 days with two or more manifestations as follows: headache, retro-orbital pain, myalgia, skin rash, bleeding manifestations and leukopenia [12]. Initially DHF can resemble DF cases with bleeding tendencies and one or more clinical manifestations, namely: Positive tourniquet test, petechial, ecchymosis, mucosal bleeding (epistaxis, gum bleeding), hematemesis or melena, thrombocytopenia (platelet count <100,000 / mm3 ), Hemo concentration as a result of increasing capillary permeability with one or more manifestations, namely: Increased hematocrit> 20% compared to standard according to age and sex. Decreasing hemorrhage 20% after receiving fluid treatment, Signs of plasma permeation, namely pleural effusion, ascites or proteinuria. If the criteria mentioned above also have manifestations of weak and fast pulse circulation, pulse pressure decreases [<20 mmHg], hypotension [according to age], cold and moist skin, and the patient appears nervous means the patient has Dengue Shock Syndrome [SSD].

2.3. Degree of DF and DHF
Dengue fever is an acute fever for 2-7 days with two or more manifestations as follows: headache, muscle pain, myalgia, and skin rash [13]. The grade of DF / DHF is classified as follows:

| DF/DHF | Grade | SYMPTOMS | LABORATORY |
|--------|-------|----------|-----------|
| DF     |       | Fever is accompanied by 2 or more signs, headache, retro-orbital pain, myalgia, and arthralgia. | Leucopenia | Thrombocytopenia, no evidence of plasma leakage was found |
| DHF    | I     | The symptoms above are added to the positive weir test. | Thrombocytopenia, (<100,000/? 1), plasma leak |
| DHF II | II    | The above symptoms plus spontaneous bleeding. | Thrombocytopenia, (<100,000/? 1), plasma leak |
| DHF III| III   | The symptoms above plus circulation failure (cold and moist skin and anxiety) | Thrombocytopenia, (<100,000/? 1), plasma leak |
| DHF IV | IV    | Severe shock is accompanied by irregular blood pressure and pulse. | Thrombocytopenia, (<100,000/? 1), plasma leak |

2.4. Dengue fever and Dengue haemorrhagic fever
In the expert system application there is a method for resolving data uncertainty problems; one of the methods used is certainty factor [14] [9][15] [16]. There are two kinds of certain factors that are used, namely the certainty factor that is filled by the expert with the rules and certainty factors given by the...
user [17]. The certainty factor that is filled by experts illustrates expert trust in the relationship between antecedent and consequent. Meanwhile certainty from users shows the amount of trust in the existence of each element in the antecedent [18]. The Certainty factor (CF) value obtained from the interpretation of "terms" from experts is converted into certain Certainty factor (CF) values according to the following table [19]:

| No | 1   | 2         | 3            | 4         | 5         | 6         |
|----|-----|-----------|--------------|-----------|-----------|-----------|
| Information | No | Not Know  | A bit of sure | sure enough | Sure | Very sure |
| User value   | 0  | 0.2       | 0.4          | 0.6       | 0.8       | 1         |

Certainty factor (CF) is one technique used to overcome uncertainty in making decisions. Certainty factor (CF) can occur with various conditions. Among the conditions that occur there is a certainty factor for rules with the same consequence. In this case we must combine the overall CF value of the existing conditions. The following formula is used according to MYCIN. The certainty factor (certainty factor) expresses trust in an event (fact or hypothesis) based on evidence or expert judgment. Certainty factor uses a value to assume the degree of confidence an expert has in a data [20].

\[
CF [H, E] = MB [H, E] \cdot MD [H, E]
\]

Where:
- CF : Certainty Factor
- MB: Measure of Belief
- MD : Measure of Disbelief
- H : Probability
- E : Evidence

Here is a description of several combinations of Certainty Factor for various conditions:

- **Certainty Factor for single premise rules:**
  \[
  CF [H, E] = CF[E] \cdot CF[rule] = CF[user] \cdot CF[expert]
  \]

- **Certainty Factor for multiple premise rules:**
  \[
  CF [A \text{ AND } B] = \text{Minimum} (CF[a], CF[b]) \cdot CF [rule]
  \]
  \[
  CF [A \text{ OR } B] = \text{Maximum} (CF[a], CF[b]) \cdot CF [rule]
  \]

- **Certainty Factor for similarly concluded rules:**
  \[
  CF \text{ Combine} (CF1.CF2) = CF1 + CF2 \cdot (1 - CF1)
  \]

3. **Methods**

In this study used software development life cycle (SDLC) Waterfall Model in building applications, this method is a system development method that each stage of development is done in sequence. In each sequence of this method, there are several things done that are like in the picture below.
4. Results
The following are the results of research that have been carried out in the form of an expert system application for Prediction of android-based dengue fever, at least an Ice cream sandwich version with 512MB RAM.

Testing this application runs well on the Android operating system version 4, besides that this application also provides results that are quite accurate when carried out experiments, the output from the system shows the results of accuracy of 97.6% based on the same indicators between system trials and trial data.

5. Conclusions
Expert systems with Certainty Factor can be used for decision support systems for Dengue Hemorrhagic Fever (DHF), with input in the form of symptoms that the user has. From some cases that were tested,
obtained accurate results which amounted to 97.6% with indicators obtained the same results between system trials and trial data.

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