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The prototype of decision support system in condition infant detection with Fuzzy Tsukamoto

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Abstract

The baby's condition is a condition that is vulnerable to environmental changes, especially weather changes. Knowledge of a mother in maintaining the health of baby also should be considered, especially in terms of nutritional intake. A healthy baby's condition affects the baby's growth and development. The development of a decision support system should be preceded by collecting and analyzing the data according to need. In this study, the variables were baby feeding items, namely Body Temperature (37.70c), Fuss (2.4), Restless (4.5), frequent bowel movements (3.7), watery bowel movements (5.6), Bloating (3.5), Nausea (3.7), vomiting (3.2) , Stomachache (2.7) and Itchy Skin (2.8). The results of the calculations will result in defoliation as follows: Measles (1:48), septic (1:48), diarrhea (1:48), ISPA (7:36), enteritis (0.77), Miliary (1:48), OMP (1:48) and varicella (1:48). The range of fuzzy values ranges from 0 to 1, indicating the baby has enteritis or stomach problems. The calculation of defuzification obtained result of 8.1, so the condition of the baby is very sick and should be handled immediately by bringing to the medical personnel.

Keywords*: baby condition, decision support system, Fuzzy Tsukamoto*

INTRODUCTION

The health condition of a maximum of 1-year-old baby is often a trouble for a young mother or a first-time baby-sitting. This noble activity is often disrupted by changes in the baby's condition out of the ordinary.

The problem of determining the level of risk of disease or diagnosis of the disease is closely connected once with a clinical decision support system (CDSS). CDSS is software designed to assist clinicians in making decisions. In this system, the characteristics of the patient data will be matched with existing knowledge in database

Fuzzy logic as one of the main components of soft computing development has proven to have a very good performance to solve the problems of uncertainty. The use of fuzzy methods intended for modeling a mathematical problem, which the mathematical concepts underlying the fuzzy reasoning is very simple and easy to use. In the fuzzy method can be run without having to go through the composition and decomposition of fuzzy, and the output value can be estimated directly from the membership value associated with its antecedent. In this study, the researchers use fuzzy

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method for decision support system (DSS) which is known as Fuzzy Inference System (FIS) using Tsukamoto. The reason in choosing the method is because the method Tsukamoto is an extension of the reasoning monotonous. At any Tsukamoto method, it is given IF-THEN rules and must be represented by a fuzzy set with monotonous membership function so that the result will be obtained by using a weighted average.

The purpose of this study is to get an idea about the design and prototype of a decision support system Fuzzy Tsukamoto method, as follows:

1. Analyze and design a baby's condition with Fuzzy Tsukamoto.
2. Decision support system models produce a baby with fuzzy condition Tsukamoto.
3. Decision support system produce a prototype application with the baby's condition Matlab application in 2010.

Decision Support Systems (DSS)

Decision Support System (DSS) or Decision Support System (DSS) is a system that can provide problem-solving ability and the ability of communicating to a problem with the condition of semi-structured and unstructured. This system is used to assist decision-making in situations of semi-structured and unstructured situations, where no one knows for sure how the decision should be made.

The decision is a series of actions that need to be followed in resolving the problem in order to avoid or reduce negative impacts or take advantage of the opportunity. A decision was taken to solve the problem by taking advantage of opportunities and reduce errors arising.

Fuzzy Logic

Some of the reasons why people use fuzzy logic:

1. Human beings have evolved to feel remarkably comfortable using, communicating and reasoning with imprecise or fuzzy terms whose applicability is a (potentially subjective) matter of degree.
2. Computers, however, do not readily share our remarkable ability to deal and reason with imprecise concepts.
3. Fuzzy logic is a type of many-valued logic that is particularly useful to formalise and reason with imprecise concepts. Consequently, many scholars see it as "a step towards formalizing human reasoning" (Freksa 1994, 21).

Thus, we believe Fuzzy Logic and this paper will be an interest to anyone interested in building Social Simulation models that contain artificial agents who can follow rules that include imprecise terms (e.g. "find an inexpensive flat which is close to work"), an ability that seems naturally intrinsic to humankind.

Brief History of Fuzzy Logic

"All traditional logic habitually assumes that precise symbols are being employed. It is therefore not applicable to this terrestrial life but only to an imagined celestial existence" Russell (1923, pp. 88–89)

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The concept of the Association of Classical or Crisp

Classical Association is realized by defining characteristic function for each element of the classical set of members. A classic example for the set of (x,0) or (x,1) shows the x member of the set A (x□A) Or x is not a member of set A (x□A). Unlike the classic set, fuzzy set used to assess the degree of membership of an element in a set. If x is a collection of objects with memberships x elements therein are referred to as the universe of discourse, then set A in X is defined as the set can be expressed in Figure 1.

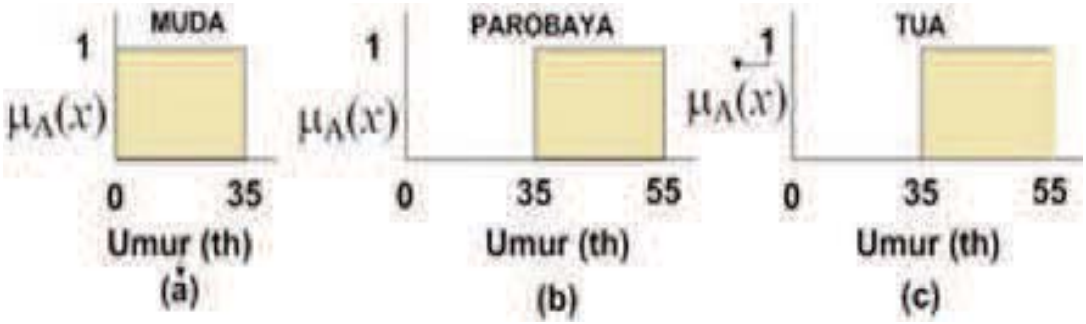

Figure 1. The concept of the association of classical or crisp

Fuzzy Tsukamoto

Tsukamoto method is an extension of the reasoning monotonous. In Tsukamoto method, each consequent upon the rules in the form of IF-THEN should be represented in a fuzzy set with membership function monotone (Sri Kusumadewi and Hari Purnomo, 2010).

Value on consistent results in every Fuzzy rules is in the form of crisp values obtained under fire strength in the antiseden. System output is generated from the concept of a weighted average of the output of each fuzzy rule. The illustration Tsukamoto method Fuzzy system can be seen in Figure 2.

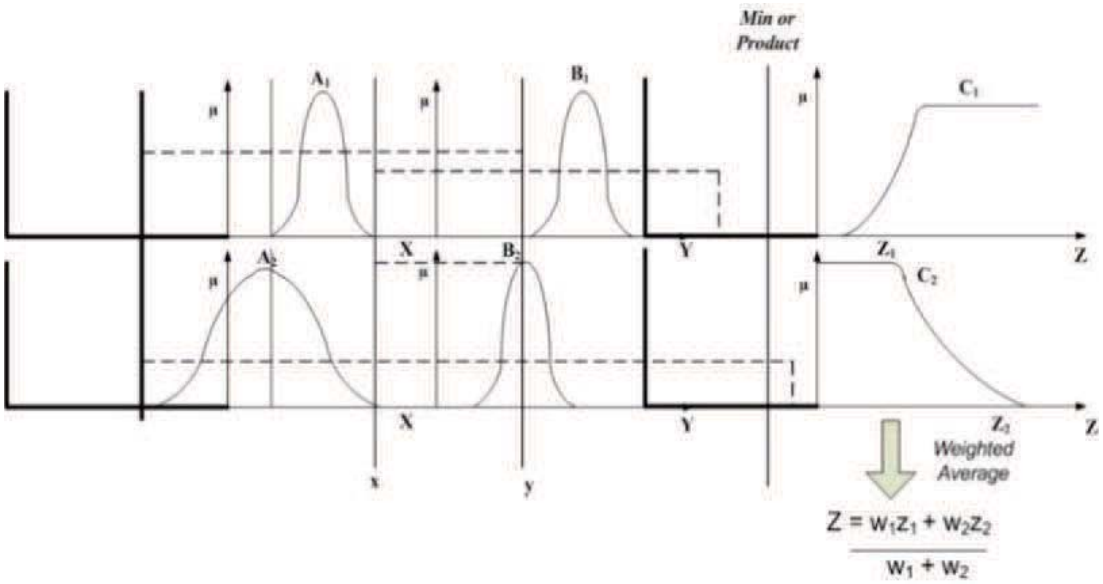

Figure 2. Model defuzzification of Tsukamoto

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RESEARCH METHODS

This study used a framework comprising the steps of identifying a problem to the application prototype models that will be produced. The frameworks are described as follows:

1. **Identification of problems**

   Problems were identified in this study is the health of newborns, especially infants up to 1 year old. Disruption to the health condition of a baby will begin with the attitude of babies who are uncomfortable with showing fidget and fuss, because of changes in the condition of the baby that is not fair.

   problem definition

   This issue is taken from the number of young or new mothers have the first child feel confused about the health problems in the baby. They are not yet accustomed to the baby's condition, especially for people on the edge of urban areas.

2. **Problem analysis**

   Analysis of the problem in this research is how to determine the condition of the baby? All can be answered by conducting research that is given to the baby's health problems from a pediatrician as experts on infant health problems, as well as some midwives who have experienced at least 5 years. So we get the baby's health condition associated with the disease suffered by the baby, such as measles, fever, diarrhea, respiratory infection and others.

3. **Research plan**

   The research plan is used to determine the steps to be carried out research. Research plan will be preceded by contacting a pediatrician who works at several locations Pekanbaru, Mulberry, Medan, Jakarta and Rokan Hulu, via a questionnaire drawn up with input from several pediatricians in Jakarta and Pekanbaru.

4. **Problem determination**

   After receiving input from pediatricians, midwives and mothers who have children or mothers who have often babysit, then in this study will be determined on a problem common symptoms and diseases that can be felt outside the box.

5. **Mapping Problems**

   The mapping is intended to facilitate the calculation of the fuzzy system. Mapping the fuzzy system will be made based on indicators or symptoms as (x) and disease as (z). So the fuzzy system will provide information on whether the conditions of a healthy baby or need handling by a pediatrician.

6. **Design of Fuzzy Logic**

   From the analysis and determination of the above problems, this study will be made a model system Tsukamoto fuzzy model. Usage Tsukamoto models in this study because it uses data that is monotonous, running without having to go through the composition and decomposition of the estimated output value directly from the membership value corresponding its antecedents. In a study to be produced draft defuzzification problem like Figure 3

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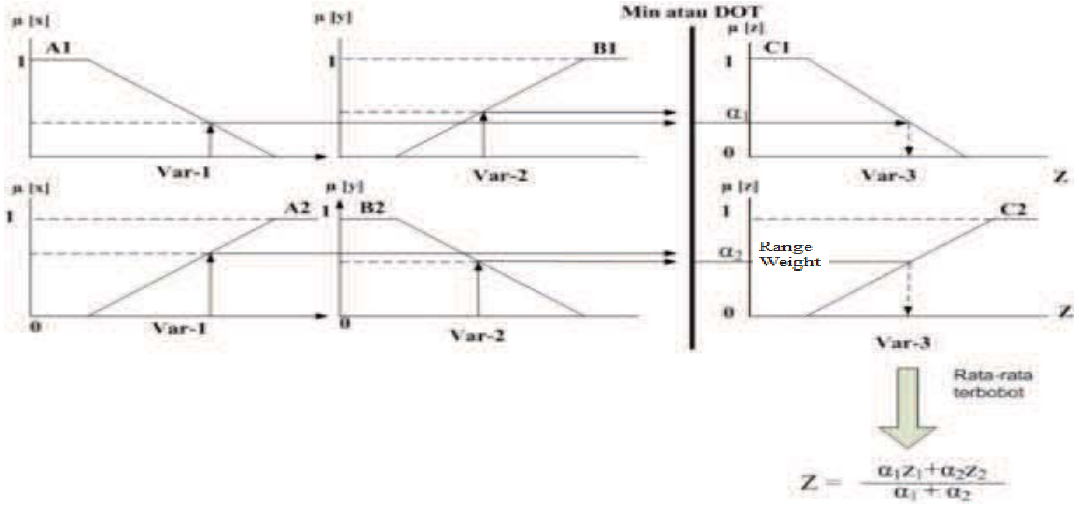

Figure 3. Draft Model deffuzifikasi Tsukamoto

1. Design of Fuzzy Logic Model

In this study will be used more than 20 variables as indicators or symptoms of pain and 8 variables as the type of disease. Of all the variables, then made the fuzzy logic in this study using Tsukamoto fuzzy model, so set a rule or rule as follows:

[R1] IF indicator 1 AND indicator 2 AND indicator n THEN Measles
[R2] IF indicator 1 AND indicator 2 AND indicator n THEN septic/Fever
[R3] IF indicator 1 AND indicator 2 AND indicator n THEN Diarrhea
[R4] IF indicator 1 AND indicator 2 AND indicator n THEN ISPA
[R5] IF indicator 1 AND indicator 2 AND indicator n THEN enteritis/Stomach Problems
[R6] IF indicator 1 AND indicator 2 AND indicator n THEN Miliary/Prickly Sweat
[R7] IF indicator 1 AND indicator 2 AND indicator n THEN OMP/Ear Infection
[R8] IF indicator 1 AND indicator 2 AND indicator n THEN Varicella/Chicken Pox

2. Fuzzy Logic Prototyping

Once fuzzy design is created, the next step is designing Fuzzy Tsukamoto DSS prototype application using Matlab, 2010. Making this prototype serves to facilitate programmers to create applications with programming languages.

Table 1. Initial Data Research

NO.	IF	INDICATOR	THEN	DISEASE
1	IF	Heat, Red Eyes, Red Spot	THEN	Measles
2	IF	Hot, Dry Lips, Red Lips	THEN	Fever / septic
3	IF	Heat, Chapter Often, Watery bowel movements	THEN	Diarrhea
4	IF	Heat, Coughs, Colds	THEN	ISPA
5	IF	Heat, vomiting, stomach pain, bloating, No Appetite, Nausea	THEN	Stomach problems / Bloating / Enteritis
6	IF	Red spots on the skin, itching	THEN	Miliary / Prickly Sweat
7	IF	Heat, ear pain / swelling, fluid in the ear	THEN	OMP / Ear Infection
8	IF	Heat, itching, red spots on the body, Freckles Containing Liquid	THEN	*varicella* / Chicken pox

(Source: information pediatricians and midwives)

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1. Prototype testing Fuzzy Model

Fuzzy logic model prototype testing can be done by inserting variable data input methods fuzzyfication, then processed results using fuzzy inference engine output Tsukamoto and will be produced in the form of defuzzyfication (Z). Once generated defuzzyfication value, then the data is connected with the answer or output variable data (Table 1) to equalize the result.

2. Evaluation Results

The calculation of the value of the variable Z performed to evaluate the results. Evaluation of the results is intended to provide an overview of the condition of the baby, so the mother will be able to determine the condition of the baby, if the baby is in a state of need of special care or not. These results will be compared with the field conditions and will be corrected with a pediatrician, so it will obtain accurate results.

3. Conclusion

The results and conclusions of this research is to see how big the disease suffered by the baby, so it can measure the value of the benefits derived from the research, especially for the development of long-term system.

RESULTS AND DISCUSSION

Implementation of this research used a knowledge base that contains knowledge derived from the literature, doctors, midwives and mothers with children. However, this study only produces baby's condition as material information on doctors, midwives or mothers with babies. The study only used fuzzy Tsukamoto since the variables namely baby is sick or unhealthy monotonously. In general, the baby has a fever, hot or fussy, so both of these inputs authors use as initial input variables to produce the output of the baby's condition.

1. Making the Knowledge Base

The development of basic knowledge in the implementation of this study used 20 input variables, in which each variable used the values down and up to determine the problems faced by the baby. Then, it was continued with a boundary blurring or fuzzification variable to the data entered.

Having obtained the basic knowledge, the researchers then determine the direction of the fuzzy, namely by making fuzzy inference system (FIS) as a machine that process the inputs into outputs, as in Figure 4.

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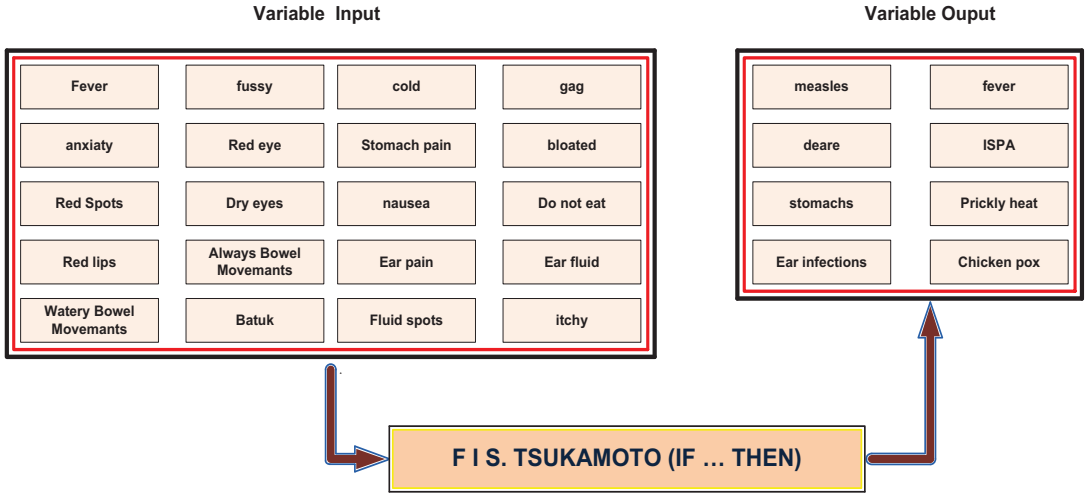

Figure 4. Flow Fuzzy Inference System Model Tsukamoto

2. Manufacture Fuzzification

In manufacture fuzzification, Tsukamoto input variables as a reference in the manufacturing process method should be clear. In developing fuzzification, the first step is to make a declaration of variables and constraints that may be used. The limit used in fuzzification area are as follows:

Suppose that a baby has a body temperature = 37.70C, Fussy = 2.4, Restless = 4.5, bowel movements = 3.7, watery bowel movements = 5.6, Bloating = 3.5, Nausea = 3.7, Vomiting = 3.2, abdominal pain and skin itchy = 2.7 = 2.8, then the determination of fuzzification area as follows:

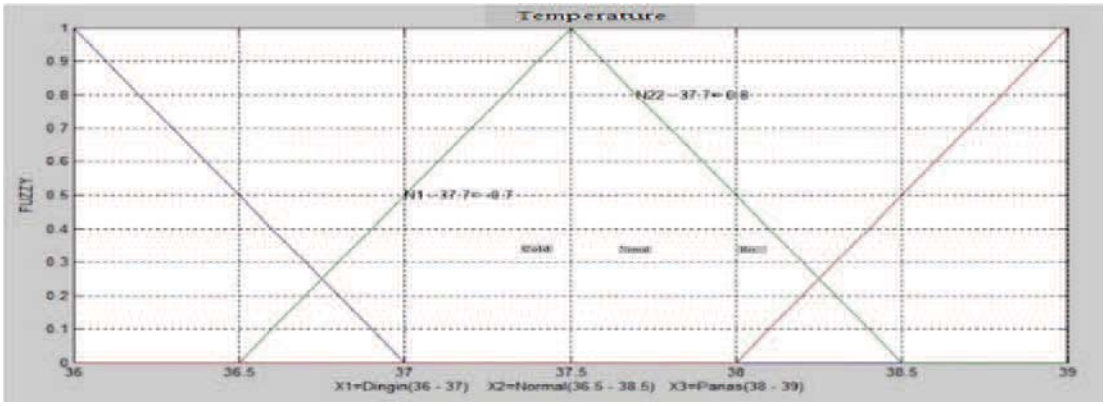

Figure 6. Display Variable Heat fuzzification 37.70C = 0.8

In fuzzification 6 variables heat of 37.70C was of 0.8, is taken from a minimum value and a positive value to approach the truth.

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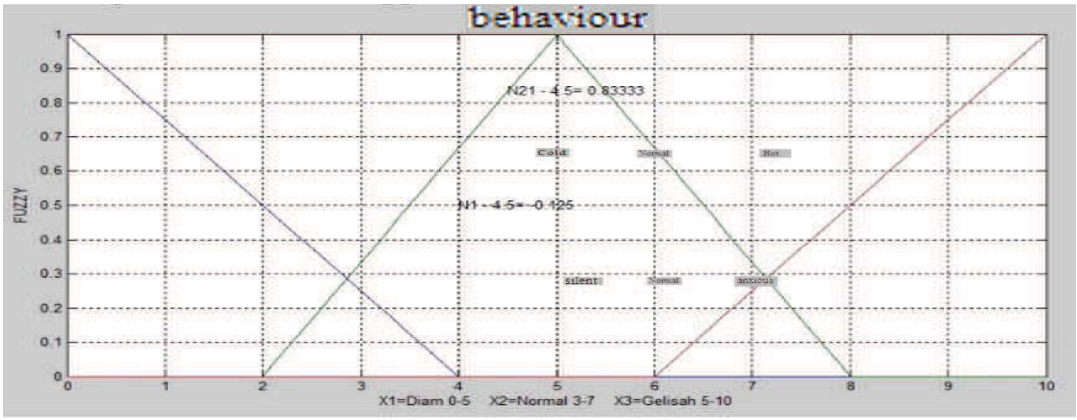

Figure 7. Fussy Variable fuzzification 2.4 = 0.125

In fuzzification 7 2.4 fussy variable is equal to 0125, were taken from a minimum value and a positive value to approach the truth.

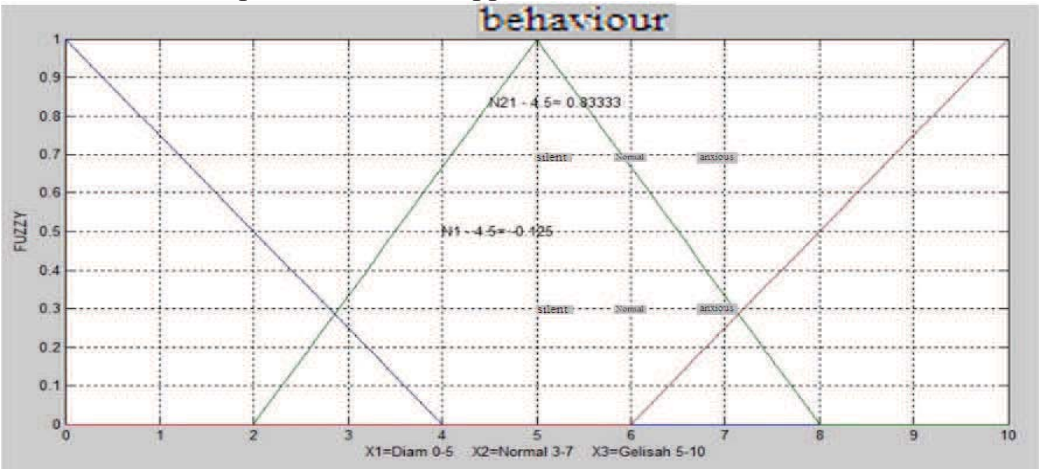

Figure 8. Display Restless variable fuzzification 4.5 = 0.8333

In fuzzification 8 agitated variable of 4.5 is equal to 0.8333, drawn from a minimum value and a positive value to approach the truth.

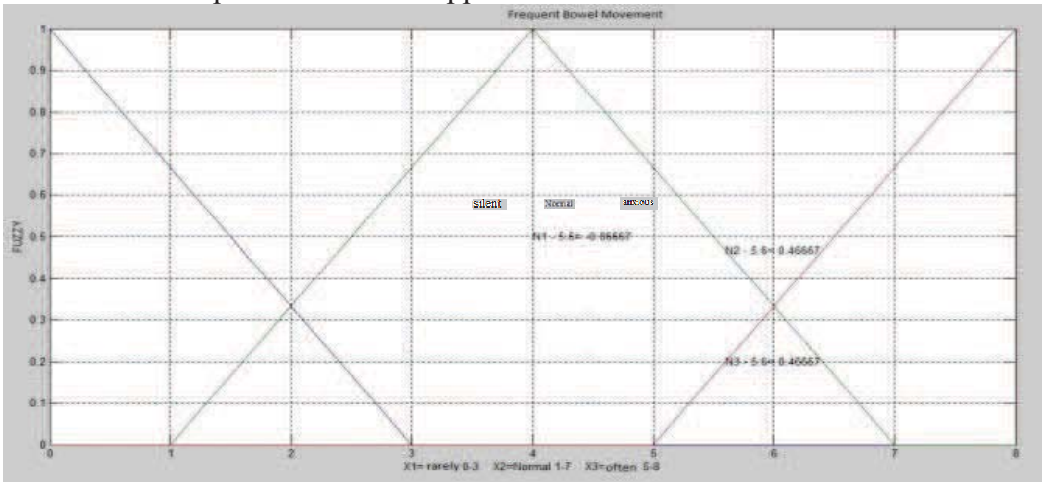

Figure 9. Display variable fuzzification Often CHAPTER 3.7 = 0.2

In Figure 9, the variable of 3.7 is 0.2, taken from a minimum value and a positive value to approach the truth.

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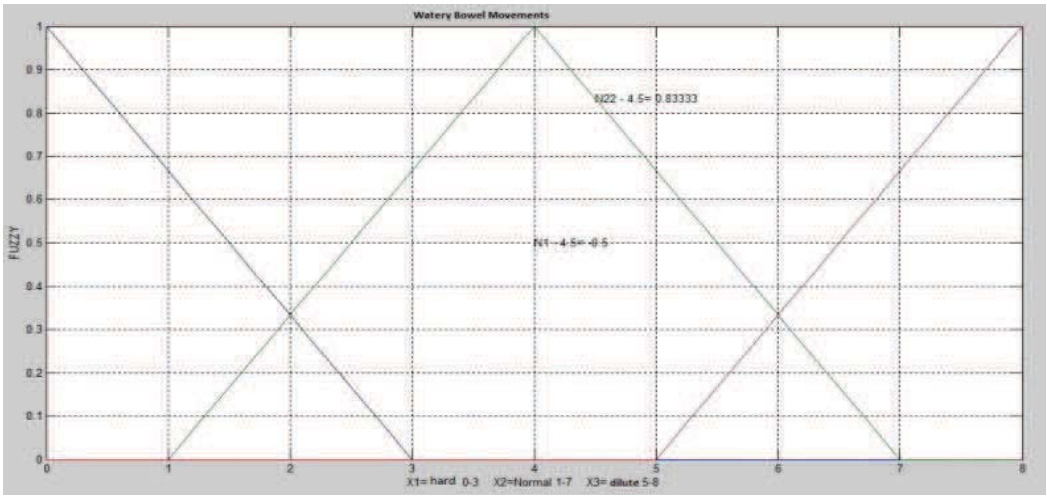

Figure 10. Dilute CHAPTER fuzzification Display 5.6 = 0.2

3. Fuzzy Inference Machine or Fuzzy Inference System (FIS)

Making Tsukamoto fuzzy inference engine system should follow the existing method, namely by using IF-THEN. Therefore it must be designed to produce the output value or defuzzification. In making the inference engine of this system using the method MIN whose value is taken from the fire strength fuzzification calculation results, so that the value obtained as follows:

[R1] = MIN (0.8, 0.2, 1, 1) = 0.2
[R2] = MIN (0.8, 0.2, 0.75, 1, 1) = 0.2
[R3] = MIN (0.8, 0.2, 0.75, 0.85, 0.2) = 0.2
[R4] = MIN (0.8, 0.75, 1, 1) = 0.75
[R5] = MIN (0.8, 0.2, 0.75, 0.6, 0.1, 0.75, 0.85, 1) = 0.1
[R6] = MIN (0.2, 0.75, 1, 0.3) = 0.2
[R7] = MIN (0.8, 0.2, 1, 1) = 0.2
[R8] = MIN (0.8, 0.2, 0.3, 1, 1) = 0.2

4. Manufacture Deffuzification

Manufacture defuzzification Tsukamoto method, by means of two-step search values, namely:

Step 1 to find the value of fire strength of each rule:

[R1] R1 = 0.2	[R3] R3 = 0.2	[R5] R5 = 0.1	[R7] R7=0.2
[R2] R2 = 0.2	[R4] R4 = 0.75	[R6] R6 = 0.2	[R8] R8=0.2

Step 2 to find the value of z each rule:

a. Lower z value

Z11 = 4-(0,2 * 4) = 3.2	z14 = 4-(0.75 * 4) = 0.8	z17 = 4-(0,2 * 4) = 3.2
Z12 = 4-(0,2 * 4) = 3.2	Z15 = 4-(0.1 * 4) = 3.6	Z18 = 4-(0,2 * 4) = 3.2
Z13 = 4-(0,2 * 4) = 3.2	z16 = 4-(0,2 * 4) = 3.2	

b. Z value of the center

Z211 = 3 + (0.2 * 2) = 2.6	z217 = 3 + (R7 * 2) = 2.6	z225 = 8- (0.1 * 3) = 7.7
z212 = 3 + (0.2 * 2) = 2.6	z218 = 3 + (R8 * 2) = 2.6	z226 = 8- (0.2 * 3) = 7.4
z213 = 3 + (0.2 * 2) = 2.6	z221 = 8- (0.2 * 3) = 7.4	z227 = 8- (0.2 * 3) = 7.4

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z214 = 3 + (0.75 * 2) = 4.4 z222 = 8- (0.2 * 3) = 7.4 z228=8-(0.2*3)= 7.4
z215 = 3 + (0.1 * 2) = 2.3 z223 = 8- (0.2 * 3) = 7.4
z216 = 3 + (R6 * 2) = 2.6 z224 = 8- (0.75 * 3) = 5.6

c. High z value

Z31 = 6 + (0.2 * 4) = 6.8 Z34 = 6+ (R4 * 4) = 9.2 z37 = 6 + (0.2 * 4) = 6.8
Z32 = 6 + (0.2 * 4) = 6.8 Z35 = 6+ (R5 * 4) = 6.4 z38 = 6 + (0.2 * 4) = 6.8
Z33 = 6 + (0.2 * 4) = 6.8 z36 = 6 + (0.2 * 4) = 6.8

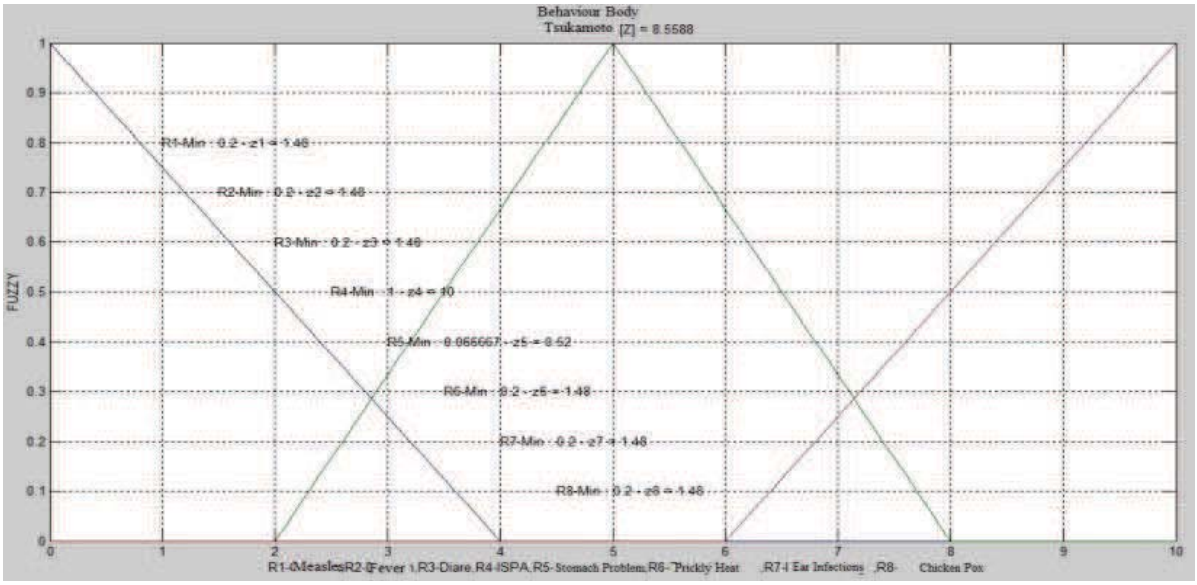

Figure 11. Display defuzzification Variable Z = 8

Figure 11 indicates that the condition of the baby is sick and should be immediately taken to the medical staff for treatment. As for the baby's illness is enteritis, of all the rules only to the rules of the smallest 5. While the condition of the baby is very sick disease, or write to the following provisions:

a. Less pain = $0 \leq Z \leq 5$.
b. Ailing = $2 \leq Z \leq 8$.
c. Very sick = $5 \leq 10 \leq 8.1$.

So that it can be ascertained that should be immediately receive treatment by medical personnel, for intensive treatment.

CONCLUSION

Input consists of 20 entries, but the baby's health condition that occurs only experiencing 10 symptoms, namely Body Temperature (37.70c), Fussy (2.4), Restless (4.5), bowel movements (3.7), watery bowel movements (5.6), bloating (3.5), nausea (3.7), vomiting (3.2), abdominal pain (2.7) and Itchy Skin (2.8). The result of the calculation will result in defuzzification is as follows: Measles (1:48), septic (1:48), diarrhea (1:48), *ISPA* (7:36), enteritis (0.77), Miliary (1:48), OMP (1:48) and varicella (1:48). Range fuzzy value ranges from 0 to 1, so that showed that babies have enteritis disease or stomach problems. Defuzzification calculation results obtained at 8.1, so the condition of the baby is very ill and had to immediately treated to the medical personnel.

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