APPLICATION FOR THE SELECTION OF STUDENTS SCHOLARSHIPS USING THE FUZZY METHOD TSUKAMOTO AT ISLAMIC COLLEGE AL-AMJAD

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Abstract: Many comments have been voiced by the community about the helplessness of sending children to school because they are constrained by the cost of education. The above problem is a complex one that exists in today's society. This can trigger the interruption of one's education period due to the inability to pay education fees. For this reason, there needs to be assistance from all parties, both private and government, in overcoming the problem. One of them is providing assistance in the form of scholarships issued by the government, companies, or educational institutions themselves. The purpose of the scholarship for outstanding students is to motivate students to always improve academic and non-academic achievement, help underprivileged but outstanding students, and foster students' confidence to be competitive in developing their potential. The purpose of this study is to design and create a system that is able to determine students who get scholarships using the fuzzy tsukamoto method. The results showed that the system can determine the students who get scholarships.

INTRODUCTION

The success of scholarship assistance to students is not measured by the absorption of funds that have been allocated but rather by the achievement of scholarship assistance for students who really need and, moreover, excel.

Perguruan Islam Al-Amjad is a school that prioritizes the advancement of Indonesian education by providing assistance to underprivileged students so that they can continue their studies to completion. The provision of scholarships so far does not use a system; it is only limited to seeing, hearing, and getting information from people connected to students who, according to the school's assessment, are entitled to assistance. This seems to be less transparent, and the data used is less measurable because there are no fixed indicators in the assessment of students who get scholarships.

With this scholarship, it can also improve the quality of human resources so that it can increase performance and productivity. One method used for the design of inference applications is the Fuzzy Tsukamoto method, where each consequence of an IF-THEN rule must be represented by a vague set with a monotonous membership function.

The final result is obtained using a weighted average. That's why Tsukamoto's method is often also called the monotonous reasoning method. This method is used as the basis for the fuzzy implication technique.

RESEARCH METHODS

3.1 Research Stages

In order for this research to be carried out and run in accordance with the steps and procedures of the study, the author designed a process of research stages, namely:

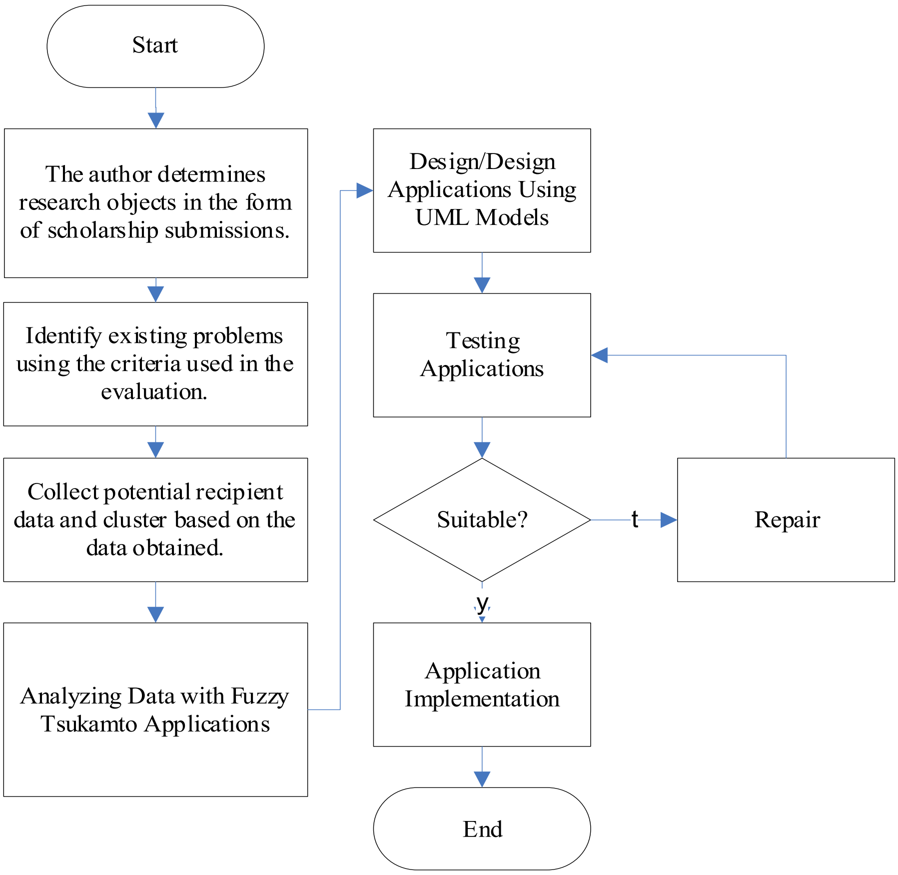

Figure 3. 1 Stages of Research

3.2 Data collection methods

a. Field Research

This is a fairly effective research method. Research with this method involves making observations and looking directly at the object under study. The field research technique is an interview.

b. Library Research

The method is carried out by reading scientific books and other source materials related to the topics discussed in the development of the system later.

The research method used is the qualitative method, which involves taking data from sources (primary data) in the form of interviews (interviews) and sorting the data. So this method is not to test hypotheses but to obtain a reliable and useful description. And this data processing does not use Statistical Data Processing (SPSS). After this, carry out the fuzzyfication process.

3.3 Tsukamoto's Fuzzy Method

3.3.1 Fuzzyfication Process

In determining students who receive scholarship assistance, there are six criteria used: average score, age of parents, amount of parental income, number of dependents of parents, number of memorizations, and results. Of the six criteria, each has two fuzzy sets, and one criterion has three fuzzy sets. More details can be seen in each of the following pictures.

a. Average Value Membership Function

The membership function of the average value is taken based on the value of the study results. The average value membership function has a range of values between 0 and 100 and will be shown in the figure below.

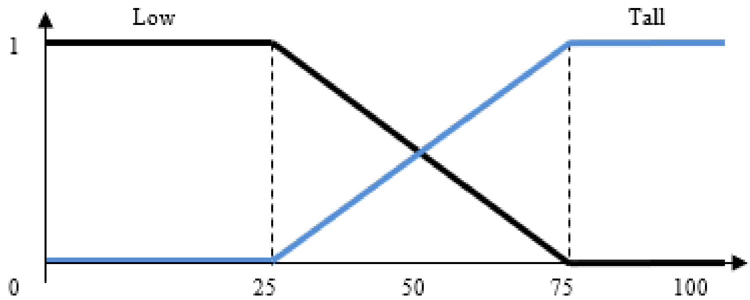

Figure 1. Average Value Membership Function

Category	Set
Low	Lower limit (25) Middle Limit (50) Upper Limit (75)

Tall	Lower limit (50) Middle Limit (75) Upper Limit (100)

Table 1. Fuzzy set for report card average score criteria

Membership (x), consists of 2 linguistic values, namely Low and High. Then the membership function is formulated as follows:

$$\mu NilaiRendah(x) = \begin{cases} 1; & x \leq 25 \\ \dfrac{(75 - \text{x})}{(75 - 25)}; & 25 \leq x \leq 75 \\ 0; & x \geq 75 \end{cases}$$

$$\mu NilaiTinggi(x) = \begin{cases} 0; & x \leq 25 \\ \dfrac{(\text{x} - 25)}{(75 - 25)}; & 25 \leq x \leq 75 \\ 1; & x \geq 75 \end{cases}$$

Here is the membership function for an alternative e.g. "Andika" with an average report card value of 80:

$$\mu NilaiRendah(80) = 0; \quad x \geq 75$$

$$\mu NilaiTinggi(80) = 1; \quad x \geq 75$$

b. Age Membership Function

Age membership functions are taken based on the age of the parents. The age membership function has a range of values between 0 to 80 and will be shown in the figure below

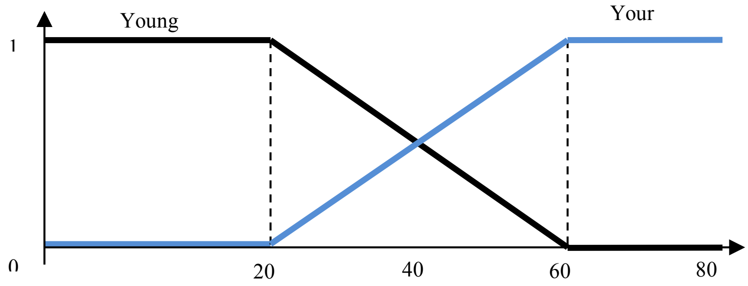

Figure 2. Age Membership Function

Table 2. Fuzzy set for age criteria

Category	Set
Young	Lower limit (0) Middle Limit (20) Upper Limit (60)
Your	Lower limit (20) Middle Limit (60) Upper Limit (80)

Membership (x), consists of 2 linguistic values, namely Young and Old. Then the membership function is formulated as follows:

$$\mu UmurMuda(x) = \begin{cases} 1; & x \leq 20 \\ \dfrac{(60 - \mathrm{x})}{(60 - 20)}; & 20 \leq x \leq 60 \\ 0; & x \geq 60 \end{cases}$$

$$\mu UmurTua(x) = \begin{cases} 0; & x \leq 20 \\ \dfrac{(\mathrm{x} - 20)}{(60 - 20)}; & 20 \leq x \leq 60 \\ 1; & x \geq 60 \end{cases}$$

Here is the age membership function for the alternative "Andika" with a value of 50:

$$\mu UmurMuda(50) = \frac{(60 - 50)}{(60 - 20)} = 0.25; \quad 20 \leq x \leq 60$$

$$\mu UmurTua(50) = \frac{(50 - 20)}{(60 - 20)} = 0.75; \quad 20 \leq x \leq 60$$

c. Parental Income Membership Function

The income membership function is based on the income conditions of the parents' working income. The membership function of the elderly income has a range of values between 0 and 5 and will be shown in the figure below.

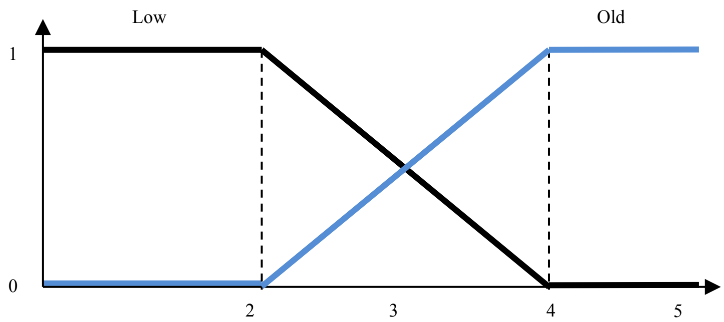

Figure 3. Parental Income Membership Function

Table 3. Fuzzy set for parental income

Category	Set
Low	Lower limit (0) Middle Border (2) Upper Limit (4)
Old	Lower limit (2) Middle Border (4) Upper Limit (5)

Membership (x), consists of 2 linguistic values, namely Low and High. Then the membership function is formulated as follows:

$$\mu PenghasilanRendah(x) = \begin{cases} 1; & x \leq 2 \\ \dfrac{(4\ - \mathrm{x})}{(4-2)}\ ; & 2 \leq x \leq 4 \\ 0; & x \geq 4 \end{cases}$$

$$\mu PenghasilanTinggi(x) = \begin{cases} 0; & x \leq 2 \\ \dfrac{(\mathrm{x}\ - 2)}{(4-2)}\ ; & 2 \leq x \leq 4 \\ 1; & x \geq 4 \end{cases}$$

Here is the function of parental income membership for the alternative "Andika" with a value of 5 (in millions):

$$\mu PenghasilanRendah(5) = 0\ ; \quad x \geq 4$$

$$\mu PenghasilanTinggi(5) = 1\ \ ; \quad x \geq 4$$

d. Parental Dependents Membership Function

The membership function of parental dependents is taken based on the condition of the number of children borne by parents. The membership function of dependent parents has a range of values between 0 and 5 and will be shown in the figure below.

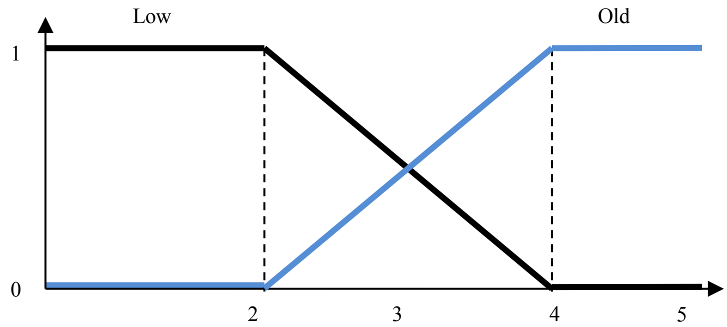

Figure 4. Parental Dependents Membership Function

Table 4. Fuzzy Set For Dependents

Category	Set
Low	Lower limit (0) Middle Border (2) Upper Limit (4)
Old	Lower limit (2) Middle Border (4) Upper Limit (5)

Membership (x), consists of 2 linguistic values, namely Few and Many. Then the membership function is formulated as follows:

$$\mu TanggunganSedikit(x) = \begin{cases} 1; & x \leq 2 \\ \dfrac{(4 - \text{x})}{(4-2)}; & 2 \leq x \leq 4 \\ 0; & x \geq 4 \end{cases}$$

$$\mu TanggunganBanyak(x) = \begin{cases} 0; & x \leq 2 \\ \dfrac{(\text{x} - 2)}{(4-2)}; & 2 \leq x \leq 4 \\ 1; & x \geq 4 \end{cases}$$

Here is the function of parental dependent membership for the alternative "Andika" with a value of 5:

$$\mu TanggunganSedikit(5) = 0\,; \quad x \geq 4$$

$$\mu TanggunganBanyak(5) = 1 \;\; ; \;\; x \geq 4$$

e. Memorize Membership Function

The function of memorization membership is taken based on the condition of the number of memorization of the Qur'an. The memorized membership function has a range of values between 0 to 20 and will be shown in the figure below

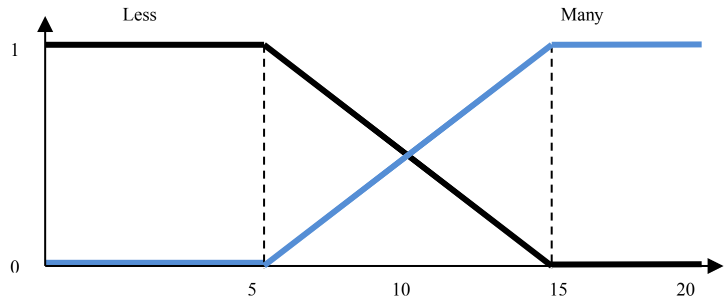

Figure 5. Memorize Membership Function

Table 5. Fuzzy Set for Hapalan

Category	Set
Less	Lower limit (0) Middle Border (5) Upper Limit (15)
Many	Lower limit (5) Middle Limit (15) Upper Limit (20)

Membership (x), consists of 2 linguistic values, namely Few and Many. Then the membership function is formulated as follows:

$$\mu HapalanSedikit(x) = \begin{cases} 1; & x \leq 5 \\ \dfrac{(15 \;-x)}{(15-5)}\;; & 5 \leq x \leq 15 \\ 0; & x \geq 15 \end{cases}$$

$$\mu HapalanBanyak(x) = \begin{cases} 0; & x \leq 5 \\ \dfrac{(x \;-5)}{(15-5)}\;; & 5 \leq x \leq 15 \\ 1; & x \geq 15 \end{cases}$$

Here is the memorizing membership function for the alternative "Andika" with a value of 18:

$$\mu HapalanSedikit(18) = 0\,; \quad x \geq 15$$

$$\mu HapalanBanyak(18) = 1 \;\;; \;\; x \geq 15$$

f. Results Membership Function

The result membership function is the output of the system. The result membership function has a range of values between 0 and 100 and will be shown in the below figure

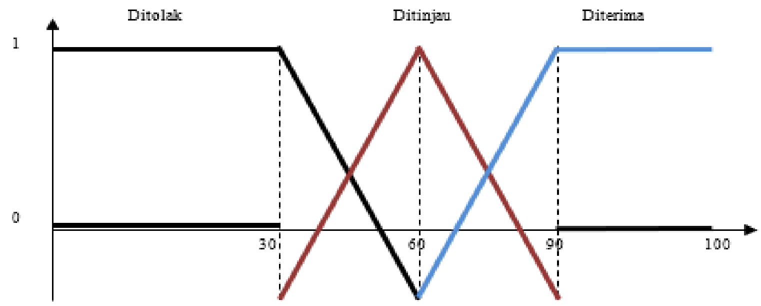

Figure 6. Quality Membership Function

Table 6. Fuzzy set for age criteria

Category	Set
Young	Lower limit (30 years) Middle Limit (45 years old) Upper Limit (60 years old)
Mid-life	Lower limit (45 years) Middle Limit (60 years) Upper Limit (75 years old)
Your	Lower limit (60 years) Middle Limit (75 years old) Upper Limit (90 years old)

Membership (x), consists of 3 linguistic values, namely Rejected, Reviewed and

Accepted. Then the membership function is formulated as follows:

$$\mu HasilDitolak(x) = \begin{cases} 1; & x \leq 25 \\ \dfrac{(\text{x} - 30)}{(60 - 30)}; & 30 \leq x \leq 60 \\ 0; & x \geq 60 \end{cases}$$

$$\mu HasilDitinjau(x) = \begin{cases} 0; & x \leq 30 \quad dan\, x \geq 90 \\ \dfrac{(\text{x} - 30)}{(60 - 30)}; & 30 \leq x \leq 60 \\ \dfrac{(90 - \text{x})}{(90 - 60)}; & 60 \leq x \leq 90 \end{cases}$$

$$\mu HasilDiterima(x) = \begin{cases} 1; & x \geq 90 \\ \dfrac{(\text{x} - 60)}{(90 - 60)}; & 60 \leq x \leq 90 \\ 0; & x \geq 90 \end{cases}$$

3.3.2 Knowledge Base

The formation of rules can be done by decision-makers by considering the weight of each predetermined criterion. In accordance with the predetermined rules, the function of implications in determining students who receive scholarship assistance based on average grades, parental age, parental income, parental dependents, and memorization is as follows

Table 7. Knowledge Base

No	Input					Conclusion
	Value	**Age**	**Income**	**Dependents**	**Memorizing**	**Result**
1	Low	Young	Low	Less	Less	Rejected
2	Low	Young	Low	Less	Many	Rejected
3	Low	Young	Low	Many	Less	Rejected
4	Low	Young	Low	Many	Many	Rejected
5	Low	Young	Tall	Less	Less	Rejected
6	Low	Young	Tall	Less	Many	Rejected
7	Low	Young	Tall	Many	Less	Rejected
8	Low	Young	Tall	Many	Many	Reviewed
9	Low	Your	Low	Less	Less	Rejected
10	Low	Your	Low	Less	Many	Rejected
11	Low	Your	Low	Many	Less	Rejected
12	Low	Your	Low	Many	Many	Reviewed
13	Low	Your	Tall	Less	Less	Rejected

14	Low	Your	Tall	Less	Many	Reviewed
15	Low	Your	Tall	Many	Less	Reviewed
16	Low	Your	Tall	Many	Many	Accepted
17	Tall	Young	Low	Less	Less	Rejected
18	Tall	Young	Low	Less	Many	Rejected
19	Tall	Young	Low	Many	Less	Rejected
20	Tall	Young	Low	Many	Many	Reviewed
21	Tall	Young	Tall	Less	Less	Rejected
22	Tall	Young	Tall	Less	Many	Reviewed
23	Tall	Young	Tall	Many	Less	Reviewed
24	Tall	Young	Tall	Many	Many	Accepted
25	Tall	Your	Low	Less	Less	Rejected
26	Tall	Your	Low	Less	Many	Reviewed
27	Tall	Your	Low	Many	Less	Reviewed
28	Tall	Your	Low	Many	Many	Accepted
29	Tall	Your	Tall	Less	Less	Reviewed
30	Tall	Your	Tall	Less	Many	Accepted
31	Tall	Your	Tall	Many	Less	Accepted
32	Tall	Your	Tall	Many	Many	Accepted

3.4 Research Design

3.4.1 Use Case Diagram

What use case diagrams do by the system and users form system modeling for use case diagrams can be seen in the following figure:

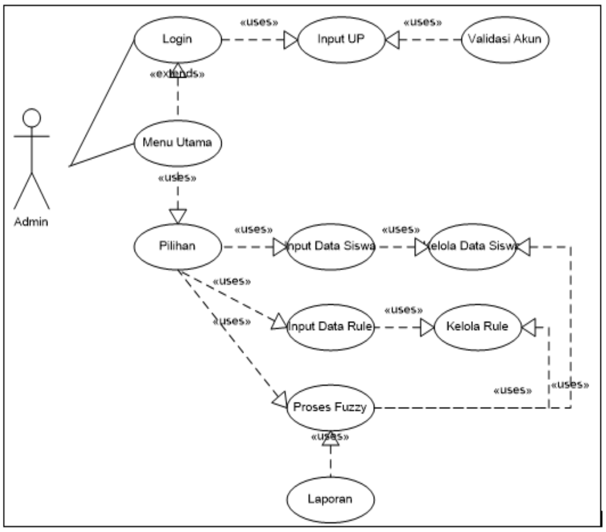

Figure 7. Use Case Diagram

3.4.2 Activity Diagram

The activity diagram shows what activities occur between the system and the user. The form of system modeling for activity diagrams can be seen in the following figure:

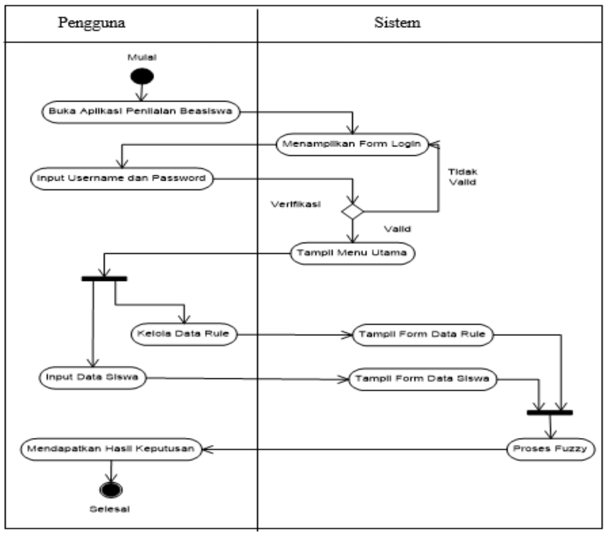

Figure 8. Activity Diagram

3.4.3 Class Diagram

Class is used to display several classes and packages in the system or software that we are using to provide an overview of the relationships contained in the system. The form of system modeling for class diagrams can be seen in the following figure:

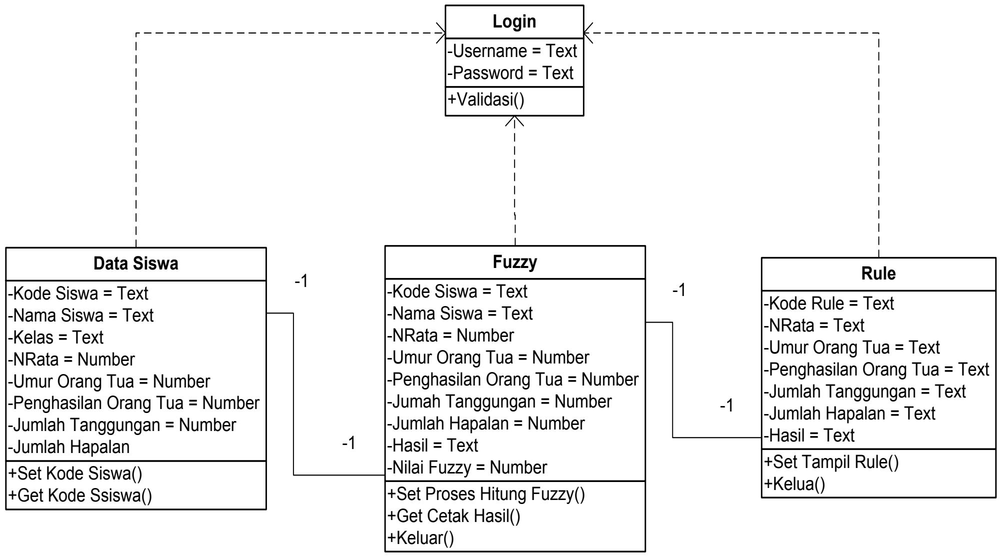

Figure 9. System Diagram Class

3.4.4 Application Testing and Discussion

This form is a form used to validate users who use the system.

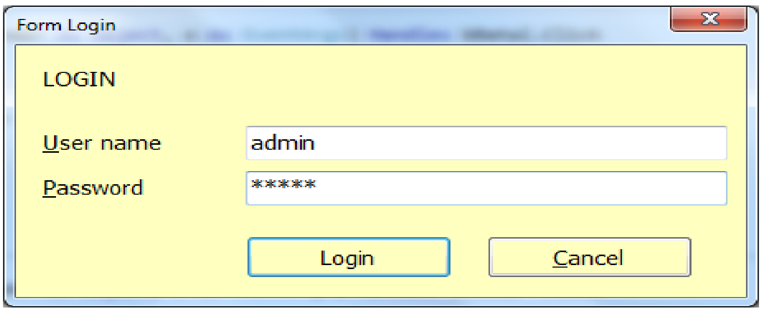

Figure 10. Login View

When this form is executed, it will enter the initial form that provides a menu of options according to system needs.

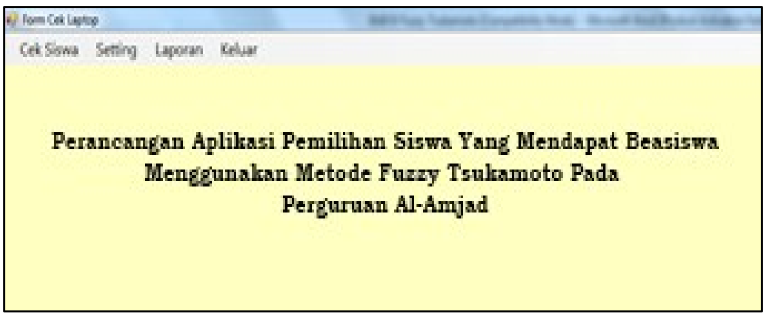

Figure 11. Main Menu

This form is used as an initial form that provides a data storage component for students. There are several components inputted, namely student code, student name, class, parent name, address, and phone and description.

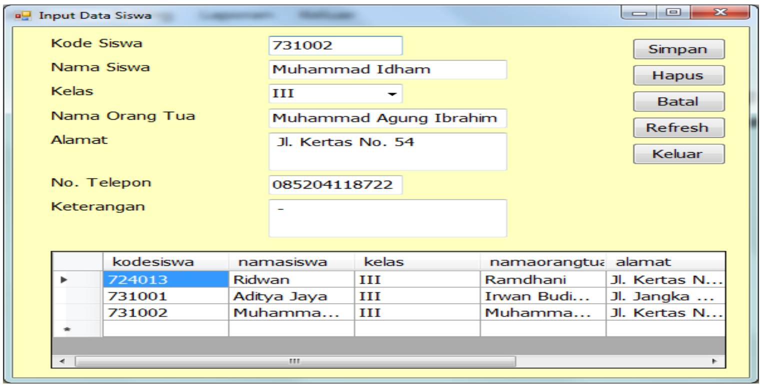

Figure 12.Student Data Form

The following form is used to validate data based on basic assessment indicators in the form of average report card scores, parents' age, parents' income, parents' dependents, and the number of students' memorization. The data inputted is quantitative data in the form of numbers. Later, the process will produce conclusions in the form of acceptance, review, or rejection.

Figure 13. Fuzzy Process Form

This form is used to display student data that has been processed and stored in the database.

Daftar Siswa Yang Mendapat Bantuan (Beasiswa)

15/07/2023

Nama Siswa	Nilai Rata-Rata	Umur Orang Tua (Tahun)	Penghasilan (Juta)	Tanggungan Orang Tua	Jumlah Hapalan	Hasil
Muhammad Idha	85	65	2	5	18	Diterima
Aditya Jaya	70	25	5	3	15	Ditinjau

Figure 14. Student Data Report View

RESULTS AND DISCUSSION

Based on the results of the analysis and the results of the implementation of the system, the author will provide the following conclusions:

1. The UML (Unified Modeling Language) model in designing the selection of students who receive assistance (scholarships) with the help of Microsoft Office Visio 2007 applications can provide an overview of the steps of activities carried out gradually related to the system built.
2. The criteria used along with the range of values for sub-criteria in determining fuzzy tsukamoto according to the needs in determining students who receive assistance
3. The resulting student selection system is able to process data automatically based on the inputted data and automatically provide conclusions, where the conclusions can be used by policymakers to make a decision in terms of assessing students who receive assistance.

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