GEOGRAPHIC INFORMATION SYSTEM OF INFORMATICS ALUMNI DISTRIBUTION USING FUZZY METHOD (CASE STUDY: UPN "VETERAN" JAWA TIMUR)

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ABSTRACT

The alumni association is an important organization in a higher education institution. Apart from being a forum for communication between graduates, alumni associations also play a major role in providing information related to career opportunities, as a medium for exchanging training information and knowledge. Informatics Study Program at UPN "Veteran" Jawa Timur already has an alumni association called IKATIFA (Ikatan Alumni Teknik Informatika). Although there is already an IKATIFA information system, the website does not have a specific system regarding alumni information in the world of work. By utilizing Geographic Information System (GIS) can present data specifically by using a map as an interface. In this research, alumni clustering was carried out using a fuzzy algorithm. There are 3 clusters, cluster 1 mean alumni work fields existing is according to study program competency, cluster 2 mean alumni work fields existing is almost according to study program competency, cluster 3 mean alumni work fields existing is not in accordance with study program competency. The test results on the testing data show that as many as 62% alumni work fields existing is according to study program competency, as many as 18% alumni work fields existing is almost according to study program competency, and as many as 20% alumni work fields existing is not in accordance with study program competency.

Keywords*: Geographic Information System, Fuzzy, Alumni, Website*

1. INTRODUCTION

Alumni and alumni associations are important assets that must be developed by every educational institution. Alumni Associations can be the spearhead in improving the reputation of the school or college in community assesment, in addition to paving the way for other alumni (especially recent graduates) to enter the workforce and build a networking [7]. This is one step to strive and optimize the existence of the Alumni Association of Informatics Study Program UPN "Veteran" Jawa Timur that already has an alumni association called IKATIFA (Ikatan Alumni Teknik Informatika). Even though this organization already has a website, it is does not yet have a system that displays information on the distribution of alumni especially alumni who already have jobs.

Geographic information system is a computer-based information system, which is designed to be able to work using data that has spatial information and has the ability to present information in graphical form using maps as an interface, so that the distribution of alumni can be known specifically [1], [5]. The purpose of this research is to build a web-based Geographic Information System for mapping the distribution of alumni and clustering the suitability of alumni's work fields with their majors. By using the Fuzzy algorithm, there are 3 clusters, cluster 1 mean alumni work fields existing is according to study program competency, cluster 2 mean alumni work fields existing is almost according to study program competency, cluster 3 mean alumni work fields existing is not in accordance with study program competency.

2. RELATED WORK

The research conducted by Vandha Pradwiyasma et al in 2013 was published by "Jurnal Sainstek UNEJ Vol. 1" discusses the decision-making process in the form of recommendations for the location of new modern stores.

Recommendations are generated using a hierarchical analysis or Analytical Hierarchy Process (AHP) using 4 assessment criteria, namely population density, residential development, the existence of traditional shops, the number of roads, the presence of modern shops. The output is a map of the distribution of modern stores along with recommendations for the location of the shop.

Research conducted by Slamet Handoko et al (August 2011) published by "Journal of Business Information Systems" discusses clustering of alumni distribution mapping using the K-Means method. An analysis was conducted on how the characteristics of the alumni distribution were correlated between the skills acquired by students while at Polines and the type of work obtained by the alumni. In this study, clusters are divided into 3 (three) types, namely Cluster 1 Alumni with fields of work according to competence, Cluster 2 Alumni with fields of work that are not in accordance with competence, Cluster 3 Alumni with fields of work not in accordance with competence The results of this study are that from 8 alumni of the Informatics Engineering Study Program in Central Java province, information on cluster 1 consists of 1 alumni or 12.5%, cluster 2 consists of 1 alumni or 12.5%, while for cluster 3 there are 6 alumni or 75.0%.

Based on the research references above, it can be It is known that the novelty element of this research is the use of web-based GIS technology to displaying the data visualization of the results of the clustering process mapping the distribution of Polines alumni into a digital map. The digital map used is a Google digital map Maps.

3. LITERATURE REVIEW

3.1 Geographic Information System (GIS)

Geographic Information System in general is a component consisting of hardware, software, geographic data and human resources that work together effectively to enter, store, repair, update, manage, manipulate, integrate, analyze and display data in an information geo-based. In a narrower sense, GIS is a computer-based system that is used to store and analyze objects and phenomena with geographic location being an important characteristic to analyze[3].

3.2 Alumni

According to the Oxford Advanced Learners Dictionary, alumni are former students or students at a particular school, institution, or university. Meanwhile, according to the Big Indonesian Dictionary, alumni are "people who have attended or graduated from a school or college"[7]. Based on these two definitions, it can be seen that alumni are students who have completed their education at an educational institution, be it formal education. as well as non-formal education. Alumni also bring their own benefits to schools or universities, both in academic and pragmatic fields, such as updating the curriculum based on relevance to the needs of the market or the world of work, and continuing education, namely schools or colleges can be developed into lifelong learning media for alumni.

3.3 Fuzzy Logic
3.3.1 Definition

Fuzzy is linguistically defined as fuzzy or vague, which means a value can be true or false at the same time. Fuzzy logic is a logic that has a value of ambiguity or ambiguity between true or false [2]. Fuzzy logic is different from ordinary digital logic, where ordinary digital logic only recognizes two states ie: Yes and No or ON and OFF or High and Low or "1" and "0". While Fuzzy Logic imitates the method of human thinking by using the concept of nature the obscurity of a value [4]. With fuzzy set theory, an object can be a member of many sets with different degrees of membership in each set. Things to know in understanding the system fuzzy, including: 1) Fuzzy Variable, 2) Fuzzy set, 3) Universe of talk, 4) Domain.

3.3.2 Membership Function

The membership function is a curve showing the mapping of input points data into its membership value (often also called with the degree of membership) which has the interval between 0 to 1. One way that can be used to get the membership value is by through a functional approach. There are several functions that can be used [6]:

1) Ascending Linear Representation.
    The increment of the set starts at the value of the domain which has membership degree 0 moves to the right towards the domain value which has degree higher membership.
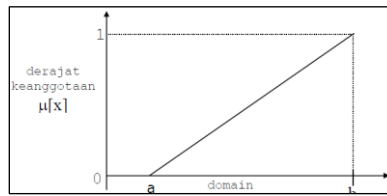
Figure 1. *Ascending Linear Representation*

Membership function :

$$\mu[x] = \begin{cases} 0; & x \le a \\ \frac{x-a}{b-a}; & a \le x \le b \\ 1; & x \ge b \end{cases}$$

2) Descending Linear Representation.
   It is the opposite of an ascending linear representation. A straight line starts from the domain value with degrees highest membership on the left side, then move decreases to the value of the domain having degree lower membership.
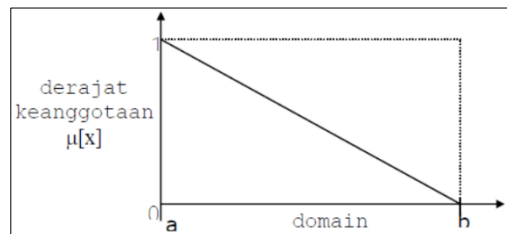

Figure 2. *Descending Linear Representation*

Membership function :

$$\mu[x] = \begin{cases} \frac{x-a}{b-a}; & a \le x \le b \\ 0; & x \ge b \end{cases}$$

3) Triangular Curve Representation
   The triangular curve is basically a combination of 2 linear lines.
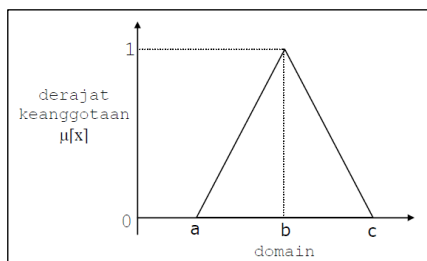
Figure 3. *Triangular Curve Representation*

Membership function :

$$\mu[x] = \begin{cases} 0; & x \le a \; atau \; x \ge c \\ \frac{x-a}{b-a}; & a \le x \le b \\ \frac{b-x}{c-b}; & b \le x \le c \end{cases}$$

4) Trapezoidal Curve Representation
   A trapezoidal curve is basically like the shape triangle, it's just that there are some points that have a value of membership 1:
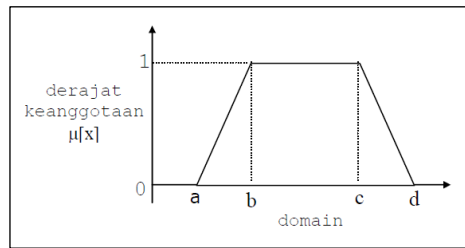
Figure 4. *Trapezoidal Curve Representation*

Membership function :

$$\mu[x] = \begin{cases} 0; & x \le a \; atau \; x \ge d \\ \frac{x-a}{b-a}; & a \le x \le b \\ 1; & b \le x \le c \\ \frac{b-x}{c-b}; & b \le x \le c \end{cases}$$

3.3.3 Fuzzy Mamdani

The Mamdani method is often also known as the Max-Min method. This method was introduced by Ebrahim Mamdani in 1975. To get the output, it takes 4 stages Formation of fuzzy sets, Implication function application (rules), Composition of rules, and Affirmation (deffuzy) [1].

4. METHODOLOGY

In the preparation of the application of fuzzy logic mapping the distribution of alumni, several steps were carried out to obtain valid data in its preparation. This is done to get the right results.

4.1 Determine the fuzzy Set

1) Occupation Variable
   The Occupation variable is used to determine compatibility of occupation with the major. Below is the Fuzzy set on occupation variable

Table 1. *Job Variable Fuzzy Set*

No	Job Value	Fuzzy Level
1.	0-12	Suitable
2.	10-14	Almost Suitable
3.	12-22	Not Suitable

The following is an implication function:

$$\mu[\text{Suitable}] = \begin{cases} 1; & x \le 8 \\ \frac{10-x}{2}; & 8 \le x \le 10 \\ 0; & x \ge 10 \end{cases}$$

$$\mu[\text{Almost Suitable}] = \begin{cases} 0; & x \le 8 \; or \; x \ge 12 \\ \frac{x-8}{10-8}; & 8 \le x \le 10 \\ \frac{10-x}{12-10}; & 10 \le x \le 12 \end{cases}$$

$$\mu[\text{Not Suitable}] = \begin{cases} 0; & x \le 10 \\ \frac{x-10}{2}; & 10 \le x \le 12 \\ 1; & x \ge 12 \end{cases}$$

2) Part/Division Variable

Table 2. Division Variable Fuzzy Set

No	Division Value	Fuzzy Level
1.	0-10	Suitable
2.	8-12	Almost Suitable
3.	10-18	Not Suitable

The following is an implication function:

$$\mu[\text{Suitable}] = \begin{cases} 1; & x \leq 8 \\ \frac{10-x}{2}; & 8 \leq x \leq 10 \\ 0; & x \geq 10 \end{cases}$$

$$\mu[\text{Almost Suitable}] = \begin{cases} 0; & x \leq 8 \; atau \; x \geq 12 \\ \frac{x-8}{10-8}; & 8 \leq x \leq 10 \\ \frac{10-x}{12-10}; & 10 \leq x \leq 12 \end{cases}$$

$$\mu[\text{Not Suitable}] = \begin{cases} 0; & x \leq 10 \\ \frac{x-10}{2}; & 10 \leq x \leq 12 \\ 1; & x \geq 12 \end{cases}$$

3) Jobdesk Variable

Table 3. Jobdesk Variable Fuzzy Set

No	Jobdesk Value	Fuzzy Level
1.	0-10	Suitable
2.	8-12	Almost Suitable
3.	10-18	Not Suitable

The following is an implication function:

$$\mu[\text{Suitable}] = \begin{cases} 1; & x \leq 8 \\ \frac{10-x}{2}; & 8 \leq x \leq 10 \\ 0; & x \geq 10 \end{cases}$$

$$\mu[\text{Almost Suitable}] = \begin{cases} 0; & x \leq 8 \; atau \; x \geq 12 \\ \frac{x-8}{10-8}; & 8 \leq x \leq 10 \\ \frac{10-x}{12-10}; & 10 \leq x \leq 12 \end{cases}$$

$$\mu[\text{Not Suitable}] = \begin{cases} 0; & x \leq 10 \\ \frac{x-10}{2}; & 10 \leq x \leq 12 \\ 1; & x \geq 12 \end{cases}$$

5. RESULT AND DISCUSSION
5.1 Interface Implementation

Here are the interface displays of the alumni information system application on geography based :

1) Login Section

The login page is used by the admin to enter the admin section page where the admin can manage data that ordinary users cannot do. The login form section display is shown in Figure.
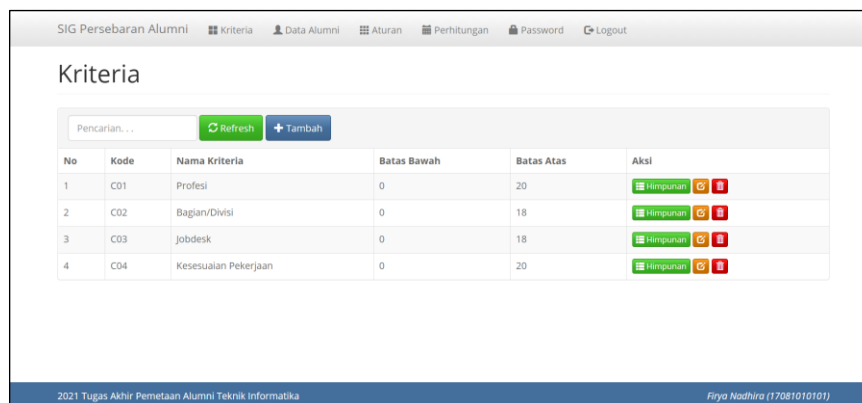

Figure 5. *Admin Login Form*

2) Home Section

The Home section is the main view of this application when logged in as an admin. This section provides a brief description of the Geographic Information System program for mapping alumni using fuzzy calculations.\

3) Criteria Section

Criteria section is a form to display what criteria will be used to perform fuzzy calculations. In addition, admins can also add data, edit data, and delete data. The following is a screenshot of the Criteria section shown in Figure 6.

Figure 6. *Criteria Section.*

4) Alumni Data Section

Alumni Data Section is a form that displays alumni data along with each value of each input variable. Admin can add data, edit data, and delete data. The following is a display of the Alumni Data shown in Figure 7.

Figure 7. *Alumni Data Page.*

5) Criteria Set Section

The criteria collection section is a form for adding the limits of the input variable values that will produce a fuzzy set diagram. Admins can also edit values and delete values. The following is a view of the Criteria Set form shown in Figure 8.
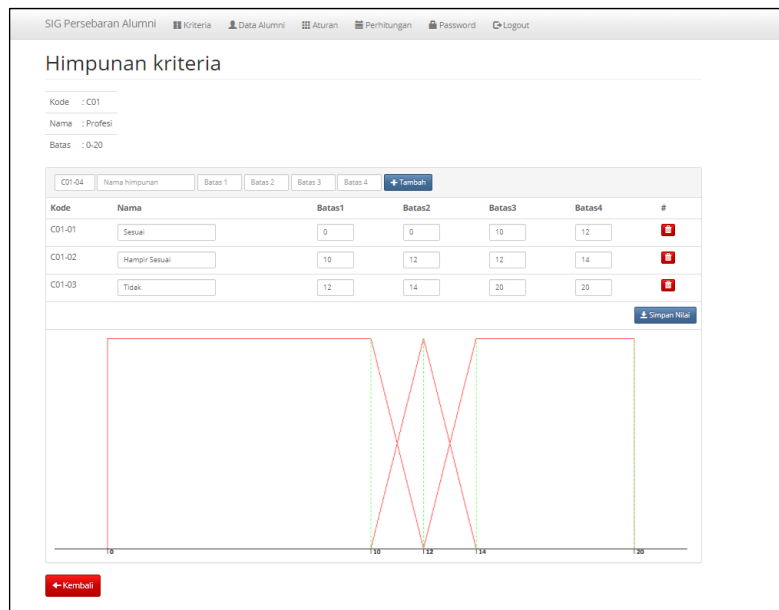

Figure 8. *Criteria Set Page.*

6) Calculation Result Section

This section is used to display the alumni data calculation results which entered by the user.

Figure 9. *Calculation Result Page.*

7) Alumni Bio Section
   Alumni Biodata Section is a form to display alumni biodata details. The details are NPM, name, class, occupation, agency name, agency address, and displaying alumni photos. The following is the display of the Alumni Biodata page shown in Figure 10.
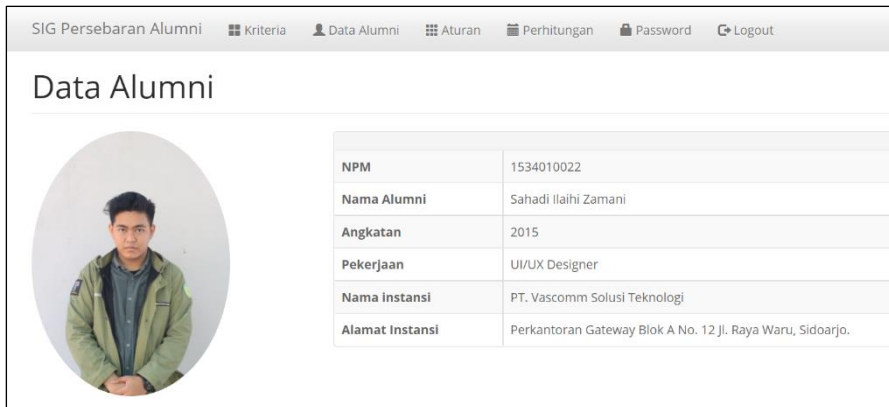

Figure 10. *Alumni Bio Page.*

8) Alumni Distribution Map Section
   The Alumni Distribution section is a form to display a map of the distribution of alumni where they work. When the location point is clicked, a popup will appear containing the alumni name, alumni workplace, workplace address, contact person who can be contacted, and detail button. When the detail button is clicked it will be directed to the Biodata page. The following is the display of the alumni distribution page shown in Figure 11.
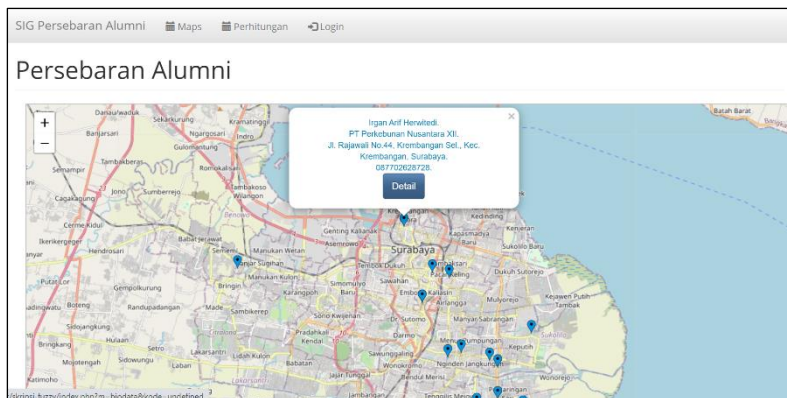

Figure 11. *Alumni Distribution Map Page*

5.2 Alumni Distribution Result

From the results of the fuzzy calculation program that the author has made, the following is a map of the distribution of Informatics Engineering alumni which is mapped into 3 clusters.
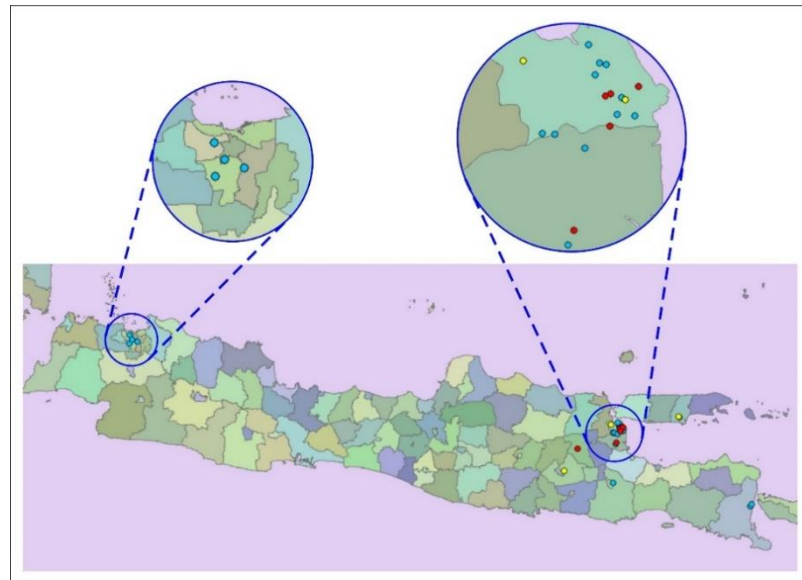
Figure 12. *Alumni Distribution Map.*

In Figure 12, there are several color dots that provide alumni mapping information. The red color means that the alumni's field of work and their major are not appropriate. The yellow ones indicate the compatibility are almost fulfilled.

It can be seen in Figure 12 that the alumni are spread over 9 cities in Jawa Timur, namely in the city of Surabaya, there are 3 alumni whose fields of work are not suitable, 2 alumni whose fields of work are almost appropriate, and 8 alumni whose fields of work are in accordance with their majors. In the city of Sidoarjo there are 2 alumni whose fields of work are not appropriate, and 2 alumni whose fields of work are in accordance with their majors. In Jombang Regency there is 1 alumni whose field of work is not in accordance with their major. In the city of Kediri, there is 1 alumni whose field of work is almost in accordance with their major. In Malang City, there is 1 alumni whose field of work is in accordance with their major. In Banyuwangi Regency, there are 2 alumni whose fields of work are in accordance with their majors. In Pamekasan Regency there are 2 alumni whose fields of work are almost in accordance with their majors. In Central Jakarta City there is 1 alumni whose field of work is appropriate, In South Jakarta there is 1 alumni whose field of work is appropriate, In East Jakarta there is 1 alumni whose field of work is appropriate, and In West Jakarta there is 1 alumni whose field of work is in accordance with his major.

To see how the graph of mapping the distribution of Informatics Engineering alumni at UPN "Veteran" Jawa Timur can be seen in Figure 13.
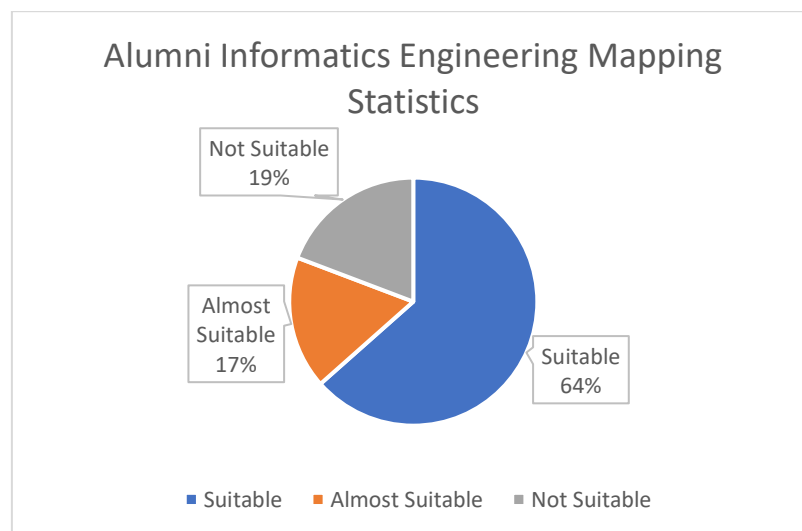

Figure 13. *Alumni Distribution Statistics*

Based on Figure 13, information was obtained that from 52 alumni of the Informatics Engineering study program at UPN "Veteran" Jawa Timur, information on cluster 1 was obtained, namely the field of work according to the department consisting of 33 alumni or 64%, cluster 2, namely the field of work almost in accordance with the department, consisting of 9 alumni. or 17%, while for cluster 3, namely the field of work that is not in accordance with the major, it consists of 10 alumni or 19%.

6. CONCLUSION

The test results on the testing data show that as many as 62% alumni work fields existing is according to study program competency, as many as 18% alumni work fields existing is almost according to study program competency, and as many as 20% alumni work fields existing is not in accordance with study program competency. In this system, clustering mechanism does not use coordinate point as the reference, meanwhile the process is based on occupation variable, division, and job description. Thus even if there is distant data from the highest cluster population still be able to join in part of the cluster.

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