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FUZZY LOGIC BASED GREGORC LEARNING SYSTEM

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ABSTRACT: In this study, fuzzy logic based Gregorc learning system is proposed to characterize learning styles of the students who have various own learning skills, intelligence levels and learning styles. Gregorc learning system helps student to notice their different ways of perceiving and ordering information. Such that student can learn by reasoning logically and intuitively; by seeing and hearing; by reflecting and acting or by analyzing and visualizing. The goal of this system is to categorize students learning style and to make instructor be able to match his teaching style with student's learning style. By this way, it is aimed to increase students success in education considerably.

Key words: Gregorc learning style, fuzzy logic

INTRODUCTION

People spend most of their time by educational activities in order to achieve learning which is the most important part of needs in their daily lives. For centuries, many studies have been done in order to answer following questions "how can i teach best", "how can an individual learn best", "how can the learned information be remembered always". By results of these researches, new education and learning methods, and new program types have been developed [1].

Education can be considered as a product of gain by experiences of family, environment, religion and mass communication mediums [1,2]. However, it should be noted that in almost every society, planned education is a mission of education schools. Regardless what comes up as a result of scientific studies, a part of education that can not be ignored certainly occurs at schools. This is how it is in global educational system of present days.
Large proportion of education occurs in school environment which exposes some problems that need to be surmounted along. One of these problems is excessive amount of students who have education at the same time. In this case, other problems can occur such that; are that much student's characteristics same thus they do have education together by the same circumstances, environment and by the same teacher? Do not these students have any diversity between each other? It can not be expected from students that have individual differences to perform same level of learning. Therefore, when these questions and excessive amount of students in the school are considered, actually, it can be concluded that individual differences must be taken into consideration [1,3].
In traditional education systems, every individual in a student group is bonded to a single program intended to group and an education method that is chosen by teacher. However, every student has various, own learning skills. Ignorance of these individual differences causes problems such that students which are more tended to chosen program, used method learning more efficiently, and others who are not tended to chosen program, couldnt learn as required [4]. Many studies such as Kolb's [5], McCarthy's [6], Honey's [7] and Fleming's [8] learning styles have been proposed about these individual properties that needed to be taken into account on education design.

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BACKGROUND

In this section, background subjects of the system such as Gregorc learning style and Fuzzy Logic Technique are described briefly.

Gregorc Learning Style

Gregorc's Mind Styles model provides an organized way to consider how the mind works. This model categorizes learning style into four groups: Abstract sequential, Concrete sequential, Abstract random, and Concrete random [9]. In abstract sequential learning model, learner likes analyzing and applying logic in solving problems. They learn best when they have access to experts or references; placed in stimulating environments and able to work alone. It is very hard for them to being forced to work with those of differing views; Repeating the same tasks over and over; dealing with lots of specific rules and regulations [9]. In Concrete sequential learning model, learner likes ordering, following directions and getting facts. They learn best when they have a structured environment; they can rely on others to complete this task; are faced with predictable situations; can apply ideas in pragmatic ways. It is very hard for them to work in groups; Working in an unorganized environment; Dealing with abstract ideas; Following incomplete or unclear directions [9]. In Abstract random learning model, learner likes to listen to others; bringing harmony to group situations; establishing healthy relationships with others; focusing on the issues at hand. They learn best when they are in a personalized environment; are given broad or general guidelines; are able to maintain friendly relationships; are able to participate in group activities. It is very hard for them being in a competition; Working in a restrictive environment; Working with people who don't seem friendly; Concentrating on one thing at a time; Giving exact details [9]. In Concrete random learning model, learners like experimenting to find answers; taking risks; using their intuition; solving problems independently. They learn best when they are able to use trial-and-error approaches; are able to compete with others; are given the opportunity to work through the problems by themselves. It is very hard for them being restricted and limitated; re-doing anything once it's done; keeping detailed records; showing how they got an answer; choosing only one answer; having no options [9].

Fuzzy Logic

Fuzzy logic deals with reasoning that is approximate rather than fixed and exact. Compared to traditional logic, fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false [10]. Fuzzification, Fuzzy Rules, Membership Functions, Inferency and Defuzzification are basic concepts of the fuzzy logic technique. The aim of fuzzification step is to determine the mapping degree of crisp inputs to fuzzy sets by using membership functions. Fuzzy rules are applied to the fuzzified inputs. Outputs of all rules are aggregated to obtain unificated output. From the fuzzy rules, probability fuzzy output variable can be obtained. The higher probability means that the node has more chance to be selected. Defuzzification is the process of transforming probability fuzzy output variable into a single crisp output [11].

THE PROPOSED SYSTEM

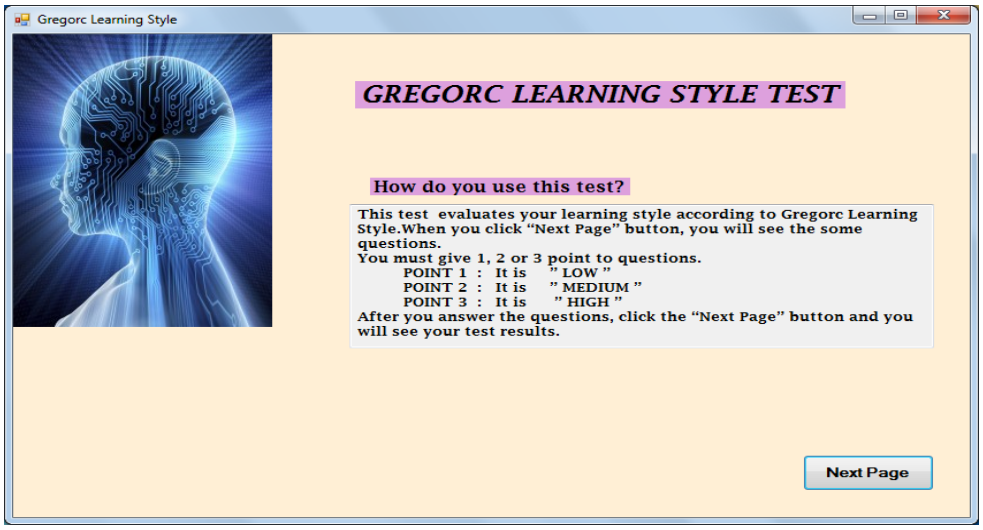
In this study a learning style inferency system which is based on fuzzy logic tehcnique and Gregorc learning model is proposed to increase the success of students in education. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Gregorc model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student's education based on the answer's of the students to the questions.

Interface

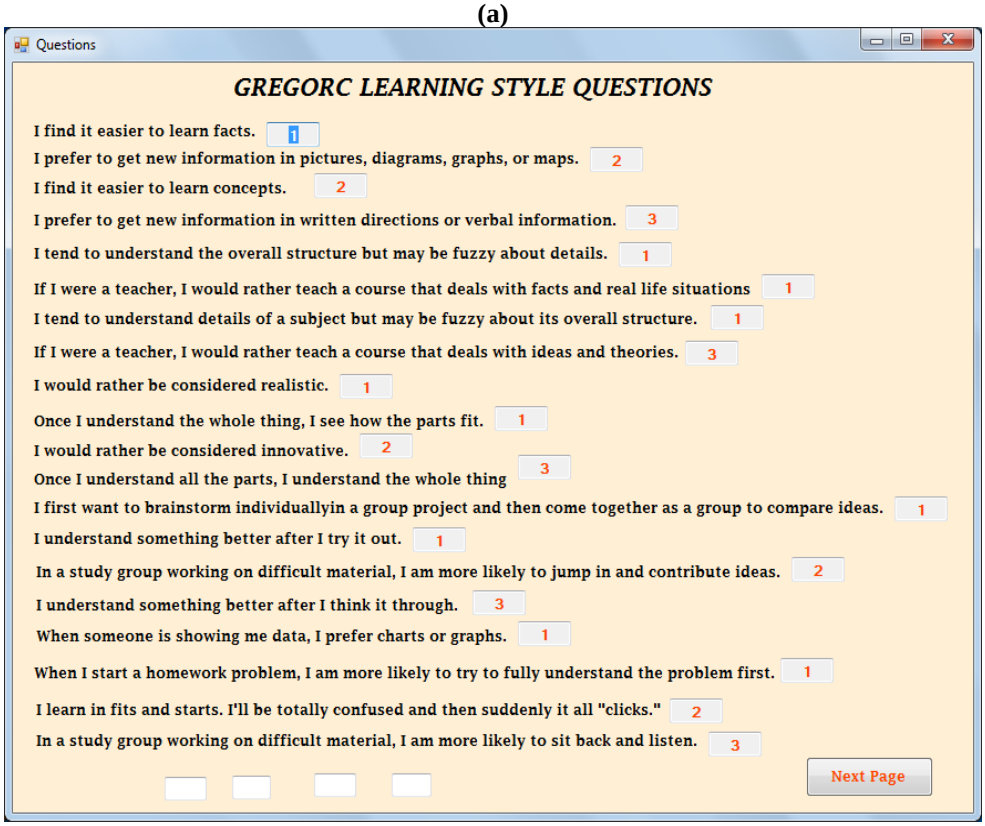
Interface shown in Figure 1 is developed by using C# programming language and includes 20 questions. A student who participates this survey gives 1, 2 or 3 point to each question. Point 1 corresponds to LOW, Point 2 corresponds to MEDIUM and Point 3 corresponds to HIGH.

1-5-9-13-17 questions' total points are for **concrete random(CR),**
2-6-10-14-18 questions' total points are for **concrete sequential(CS),**
3-7-11-15-19 questions' total points are for **abstract random(AR)**,
4-8-12-16-20 questions'total points are for **concrete sequential(AS)**,

Table 1. Linguistic Variables And Their Fuzzy Value Range		
Question System Value	**Linguistic variables**	**Fuzzy value**
5-6-7	LOW	0.00<= x < 0.3
8-9-10-11-12	MEDIUM	0.03<= x < 0.7
13-14-15	HIGH	0.7 <= x <= 0.1



(a)



(b)

Figure 1. Interface of Gregorc Learning Style

Education style is decided in accordance with the total points which are obtained from the answers of questions. Figure 2 shows the interface of Gregorc Learning Style Test Result.

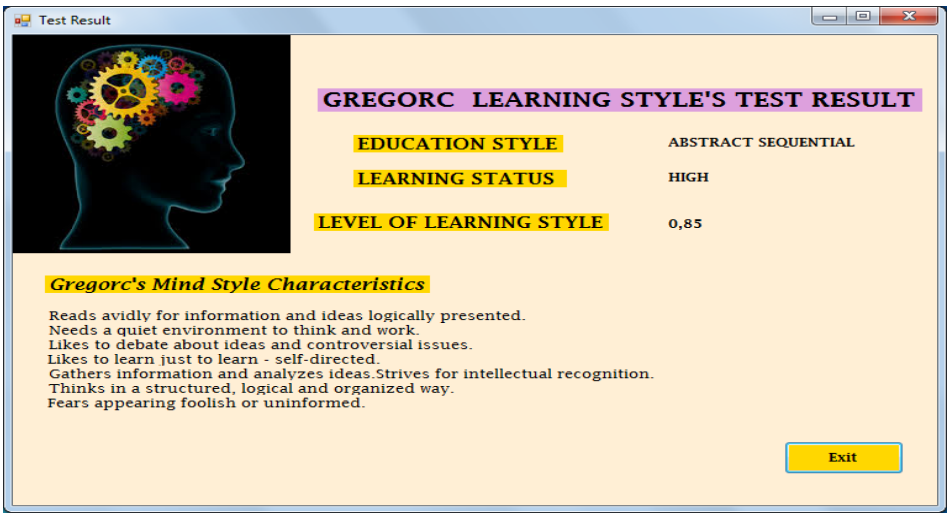


Figure 2. Interface of Gregorc Learning Style Test Result

Fuzzy Logic Based Inferency System

Four input parameters namely Abstract Sequential (AS), Concrete Sequential (CS), Abstract Random (AR), and Concrete Random (CR) and one output namely Education Style (EduStyle) are determined in the proposed fuzzy logic based system which is shown in Figure 3.

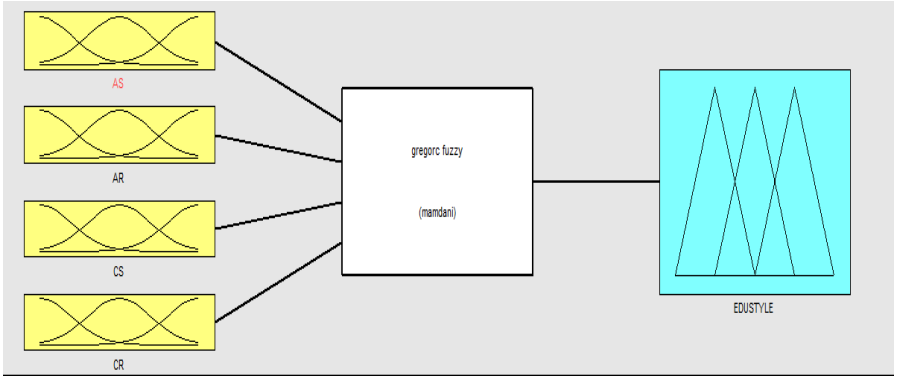
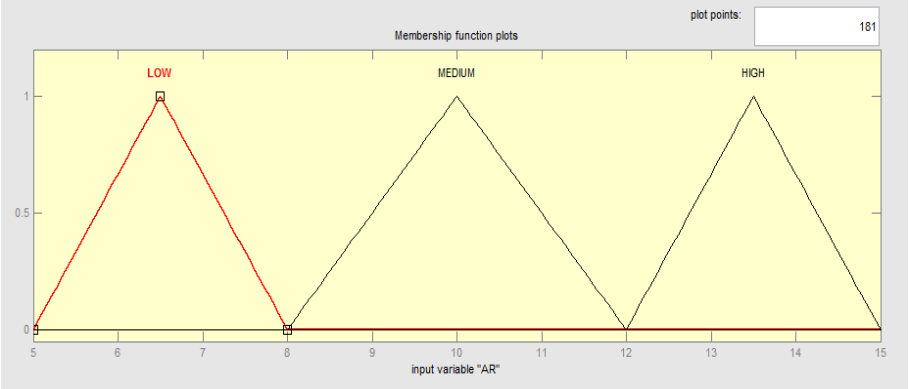
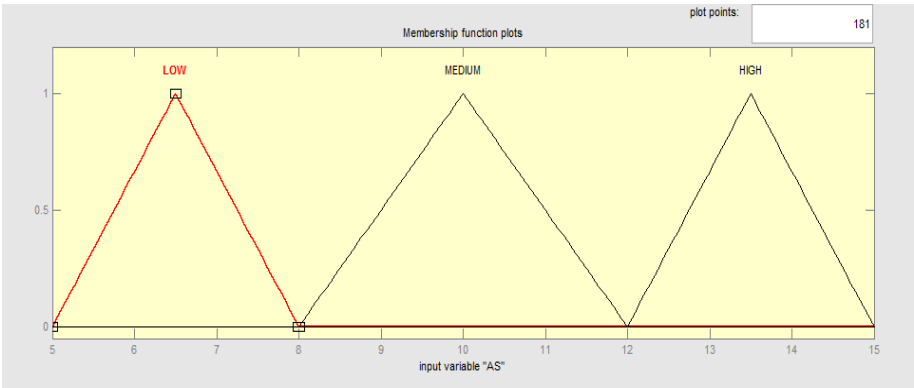


Figure 3. The Proposed Fuzzy Logic Based Inferency System

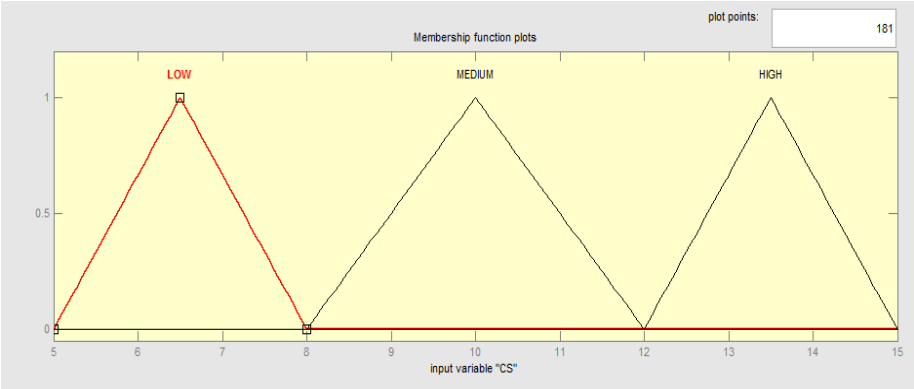
The fuzzification method involves the transformation of raw input variables and evaluation of the linguistic variables using the triangular Membership Functions as shown in Figure 4.



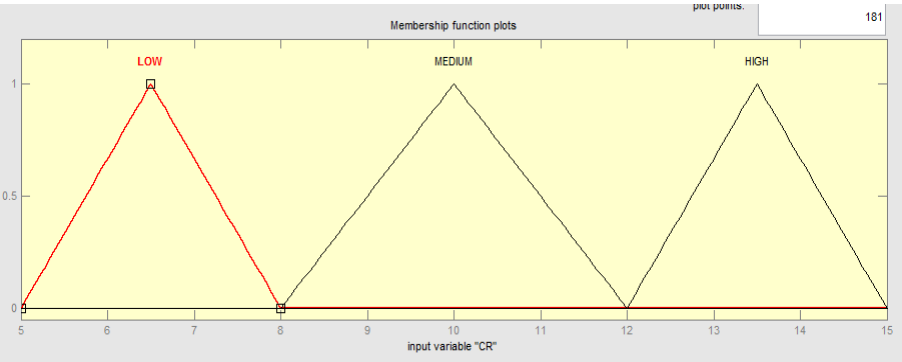
(a)Input for Abstract Random



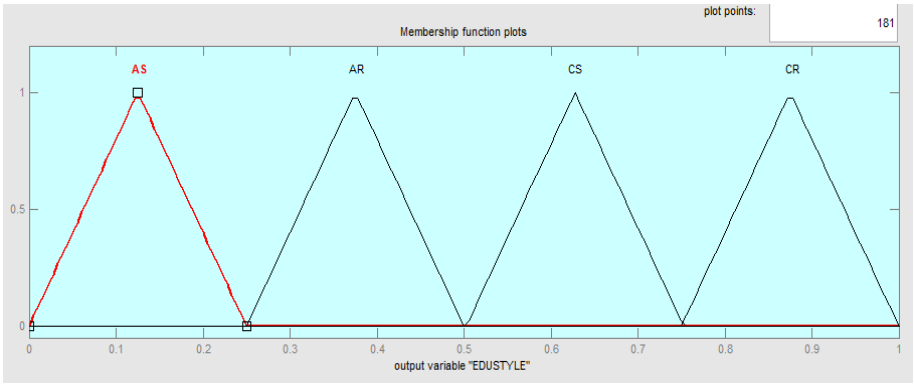
(b)Input for Abstract Sequential



(c)Input for Concrete Sequential



(d)Input for Concrete Random



(e)Output

Figure 4. Membership Functions of The Proposed System

The rule base of Gregorc Learning styles testing is characterized by a set of IF THEN rules in which the antecedents (IF parts) and the consequents(THEN parts) involve linguistic variables. An example of rule determined in the system is shown in Figure 5.

IF AS is HIGH **AND** AR is MED **AND** CS is MED **AND** CR is LOW **THEN** LEARNING STYLES is AS.

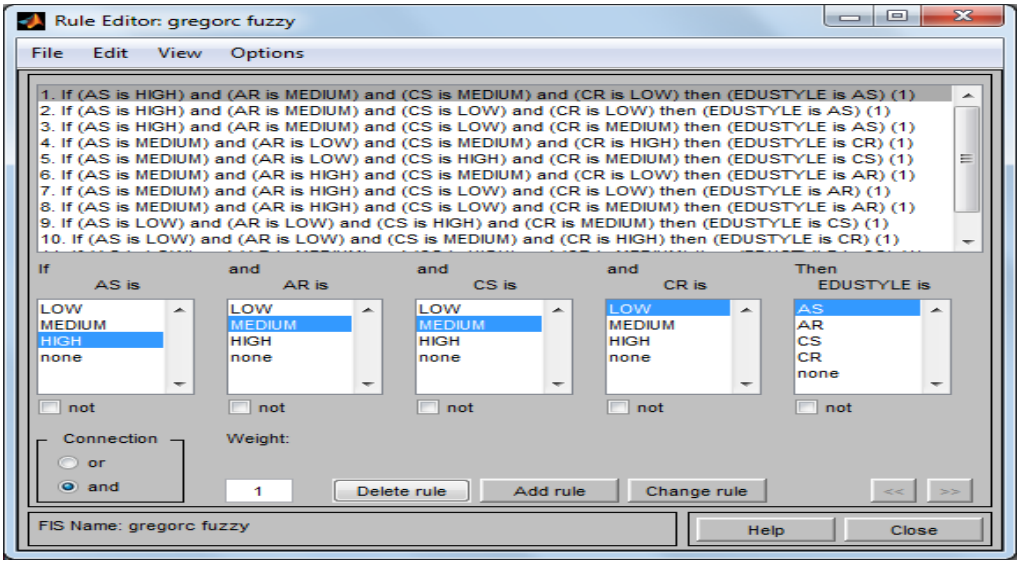


Figure 5. An Example Rule of The Proposed System

Lastly Centroid of Area (CoA) method is used for the defuzzification step.

RESULTS AND FINDINGS

Figure 6 shows an example operation of our system for the input parameters of values: AS: 6.74, AR:9.08, CS: 11 CR: 13.5 correspond to LOW, MEDIUM, MEDIUM and HIGH fuzzy degrees respectively. According to the fuzzy rule *"If (AS is LOW) and (*AR *is MEDIUM) (CS is MEDIUM) and (*CR *is HIGH) then (LEARNING STYLE is CR)*". The proposed system inferences that, these input values correspond to the value of 0.875 for the *Concrete Random* learning style crisp output. The Surface Screen Interface of the Proposed Fuzzy Logic Model is shown in Figure 7.

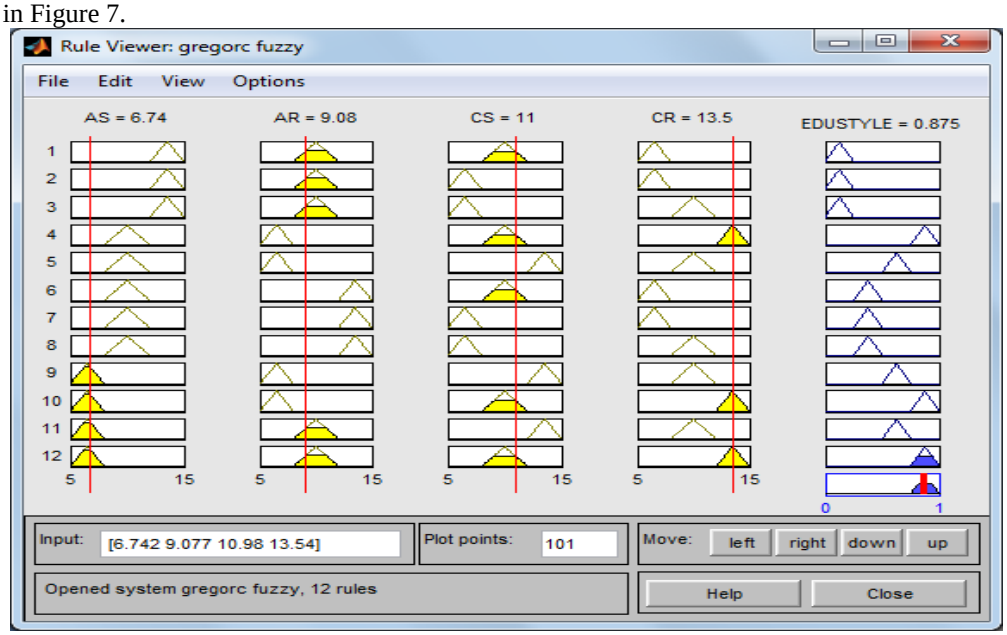


Figure6. An Example Output of the Proposed System

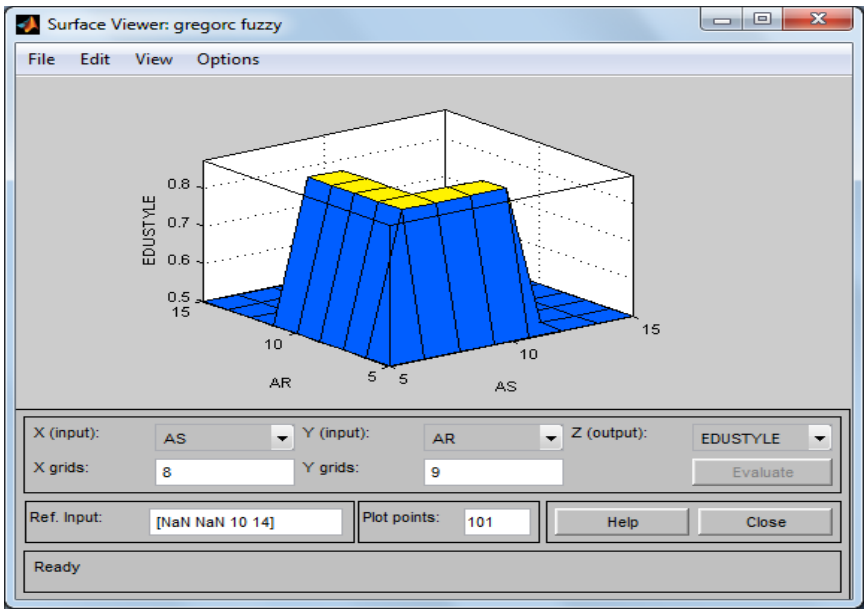


Figure7. The Surface Screen Interface of the Proposed System

CONCLUSION

In this study, fuzzy logic based Gregorc learning system is proposed to characterize learning styles of the students who have various own learning skills, intelligence levels and learning styles. In order to achieve this, a software which provides an interface including 20 questions in accordance with the Gregorc model is developed. Fuzzy logic technique is used to preference which learning style is suitable for the student's education based on the answer's of the students to the questions. By categorizing students learning style, instructor will be able to match his teaching style with student's learning style. By this way, it is aimed to increase students success in education considerably.

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