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A LEARNING STYLE INFERENCE SYSTEM BASED ON FUZZY LOGIC TECHNIQUE

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ABSTRACT: There are many reasons why education is very important in daily life and business. Such that learning will continue every time parallel to the rapid developments and changes in innovation and the technology. In this study, fuzzy logic based dunn learning style inference system is developed to measure student's success in learning. Dunn learning style identifies five important factors on which student learning style differs; namely environmental, emotional, sociological, physiological, and psychological. In this study, a software system is developed and an interface which includes some questions in relation with Dunn learning style is designed. Answers of the students are rated and given as an input to the proposed fuzzy logic engine. The proposed software system inferences Education Style, Learning Status and the Level of Learning Style of the student. By this way, the instructor will be able to match his teaching style with student's learning style which contributes to student's success in education field.

Key words: Dunn learning style, fuzzy logic, inference system

INTRODUCTION

Because of the differences in abilities, personalities, identities and characteristic features of the people, each person prefers different learning styles and techniques. In order to learn easily ve rapidly, people use the most convenient learning style. Recognizing learning style is very useful to students because it allows students to have a better chance of overcoming any difficult situation, to be successful on their education programme, to effectively target areas where an improvement is required and to enjoy their learning process[1].
In this study, fuzzy logic technique is used to inference which learning style is more suitable to the student's learning skils. [2-6] are some of the studies that use Fuzzy logic technique in education field. Dunn Learning Style is chosen for implementing and analyzing the developed system. In the following sections, background that includes fuzzy logic technique and Dunn learning style are described briefly. After that, the proposed system which is composed of interface and fuzzy logic parts is explained in detail. Lastly, simulation results are given and evaluated.

BACKGROUND

In this section, Dunn learning style and Fuzzy Logic Technique are described briefly.

Dunn Learning Style

According to Dunn, environmental, emotional sociological, physiological, and psychological are the five key factors that effect the efficiency of student learning style [7].

Environmental: Ideal place to learn can differ in accordance with the students characteristic features. While some of the students can learn better i a warm, bright place with many people, some of them can prefer cooler and quite places [7].

Emotional: While some students can achive a long-term project and monitor and pace themselves until completing the job, the others may need considerable support [7].

Sociological: Reaction to peer interaction can also differ student to student. While some students prefer to learn by themselves, the others can prefer to work with a group [7].

Physiological: Learning modality, mobility and time are important elements related to individual differences in terms of physiological preferences [7]

Psychological: While students attack to learn problems, some of them can approach globally and look at big Picture, some of them prefer to address individual elements of a problem separately [7].

Fuzzy Logic Technique

Fuzzy logic deals with reasoning that is approximate rather than fixed and exact. Fuzzification, Fuzzy Rules, Membership Functions, Inference 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 [8].

The Proposed System

In this study a learning style inference system which is based on fuzzy logic technique and Dunn Learning Style 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 Dunn Learning 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. 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** questions' total points are for **ENVIRONMENTAL**
2-6-10-17 questions' total points are for **EMOTIONAL**,
3-7-14-18 questions' total points are for **PHYSIOLOGICAL**,
4-11-15-19 questions' total points are for **ENVIRONMENTAL**,
8-12-16-20 questions' total points are for **SOCIOLOGICAL**

Table 1. Linguistic variables and their fuzzy value range		
Question System Value	**Linguistic variables**	**Fuzzy value**
4-5-6	LOW	$0.00 <= x < 0.3$
7-8-9-10	MEDIUM	$0.03 <= x < 0.7$
11-12	HIGH	$0.7 <= x <= 0.1$
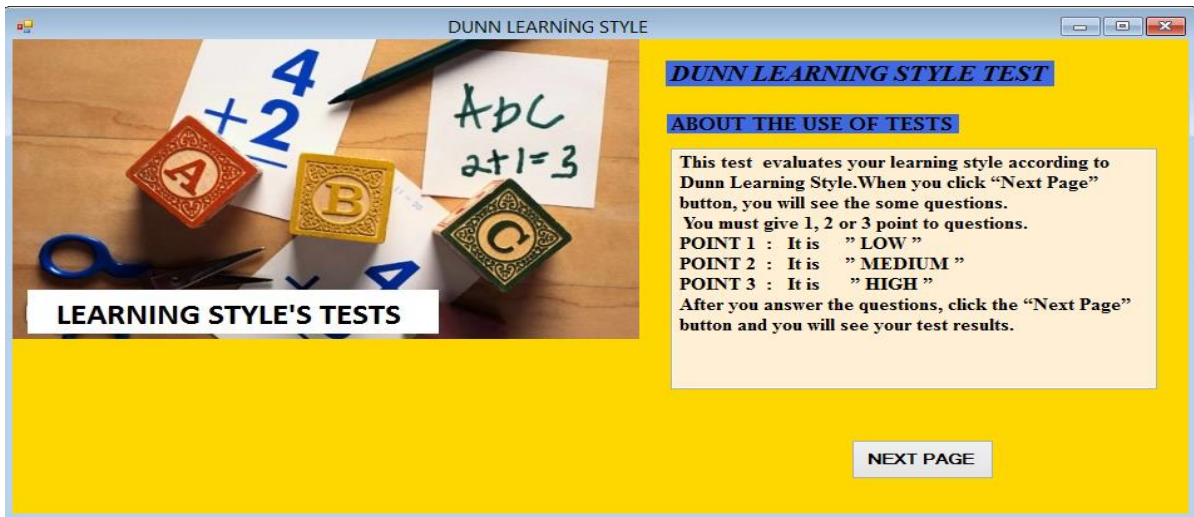
(a)

(b)

Figure 1. Interface of McCarthy Learning Style

Education style is inferenced via Fuzzy Logic Technique in accordance with the total points which are obtained from the answers of questions. Figure 2 shows the interface of Dunn Learning Style Test Result.

Figure 2. Interface of McCarthy Learning Style Test Result

Fuzzy Logic Based Inference System

Four input parameters namely ENVIRONMENTAL, EMOTIONAL, PHYSIOLOGICAL, SOCIOLOGICAL and one output namely Learning Style are determined in the proposed fuzzy logic based system which is shown in Figure 3.
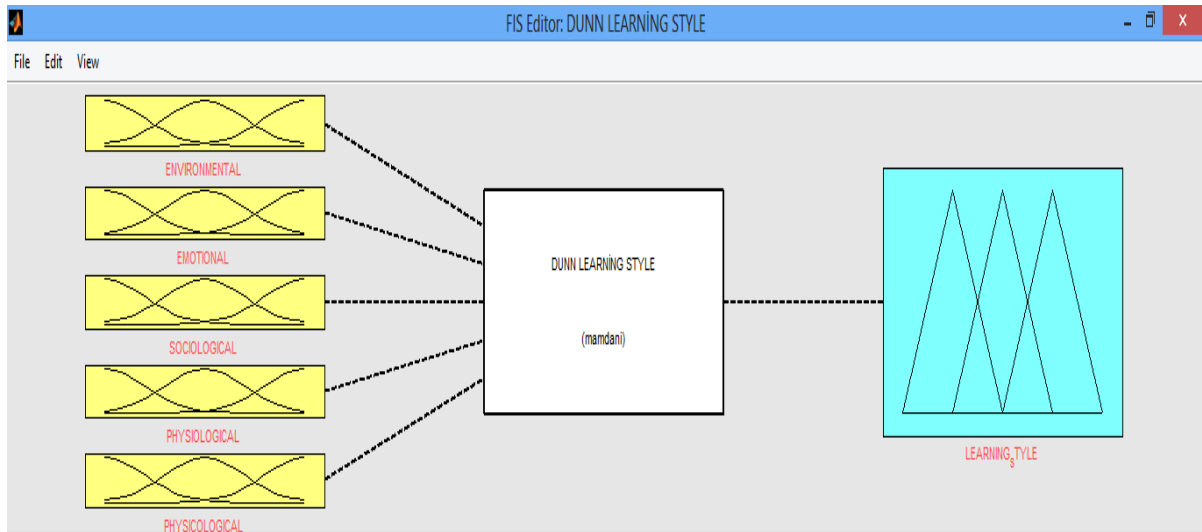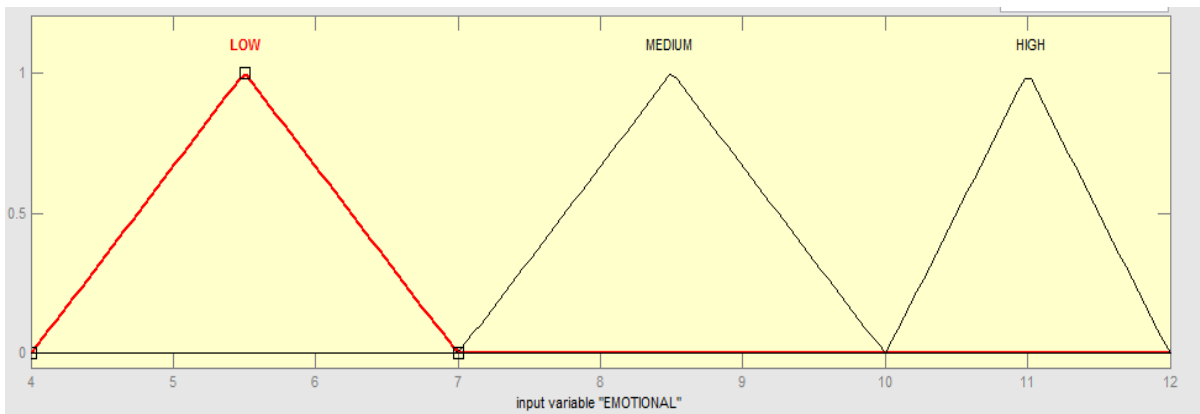

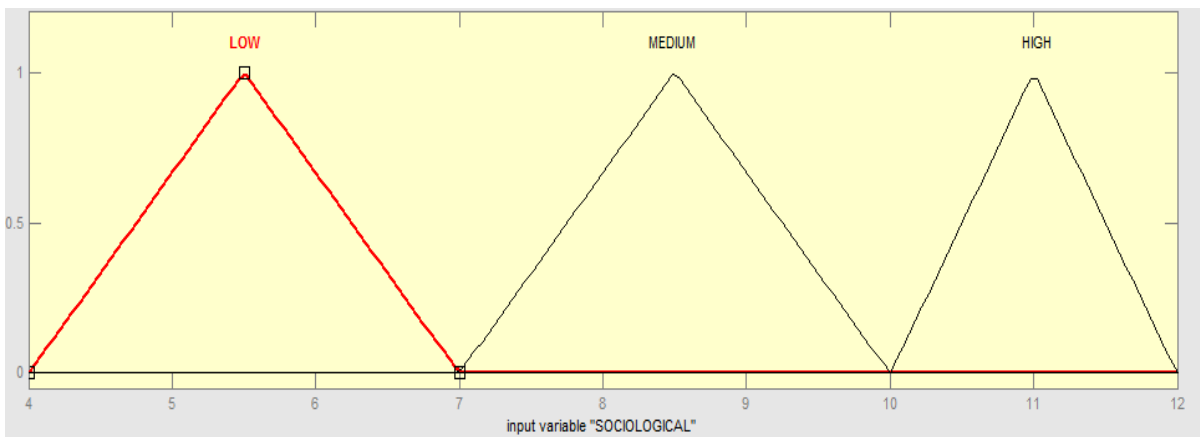**Figure 3. The Proposed Fuzzy Logic Based Inference System**

The fuzzification method involves the transformation of raw input variables and evaluation of the linguistic variables by using the triangular Membership Functions as shown in Figure 4.
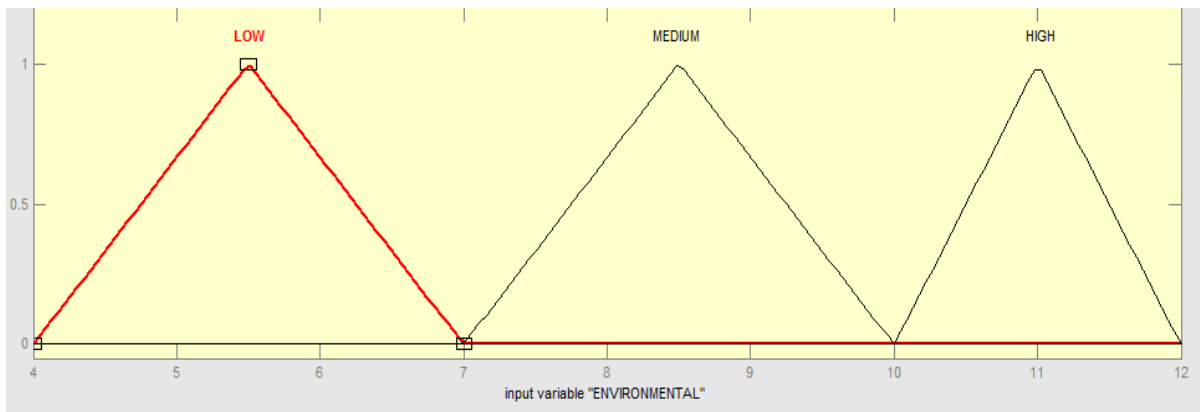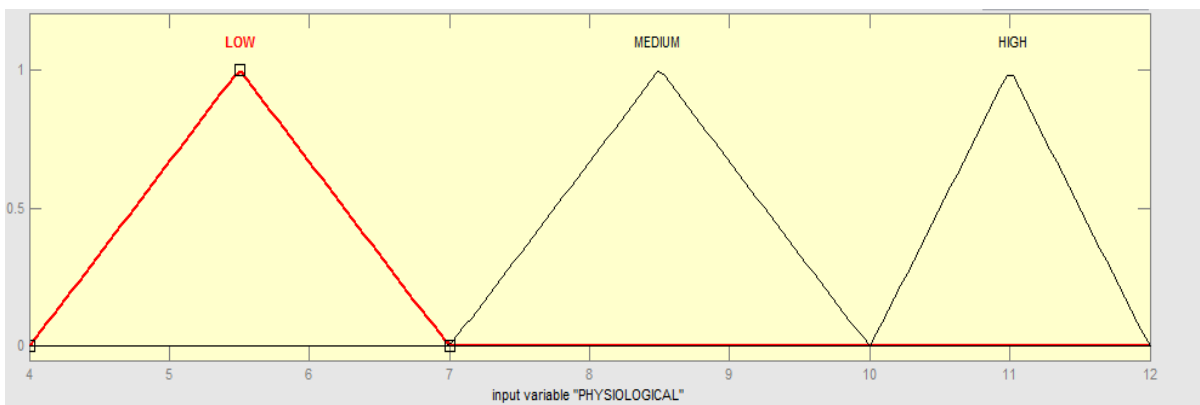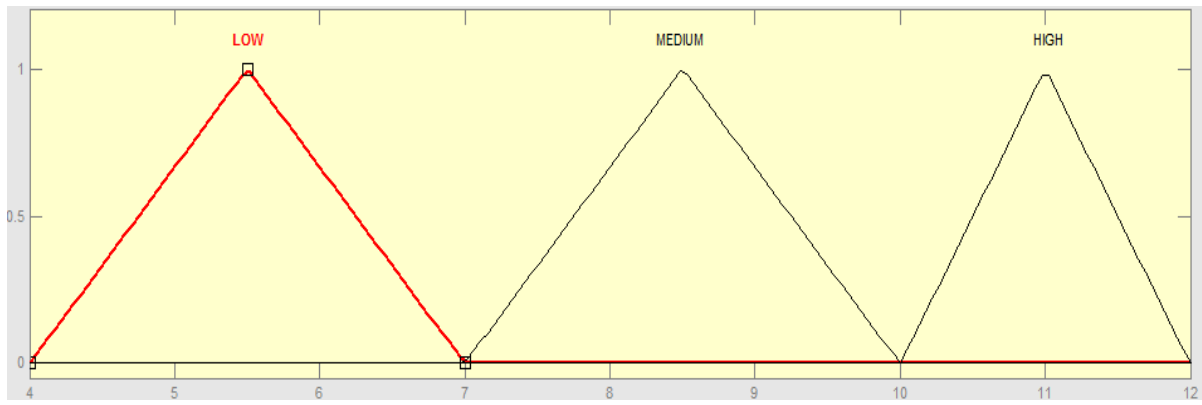
(a)Input for ENVIRONMENTAL
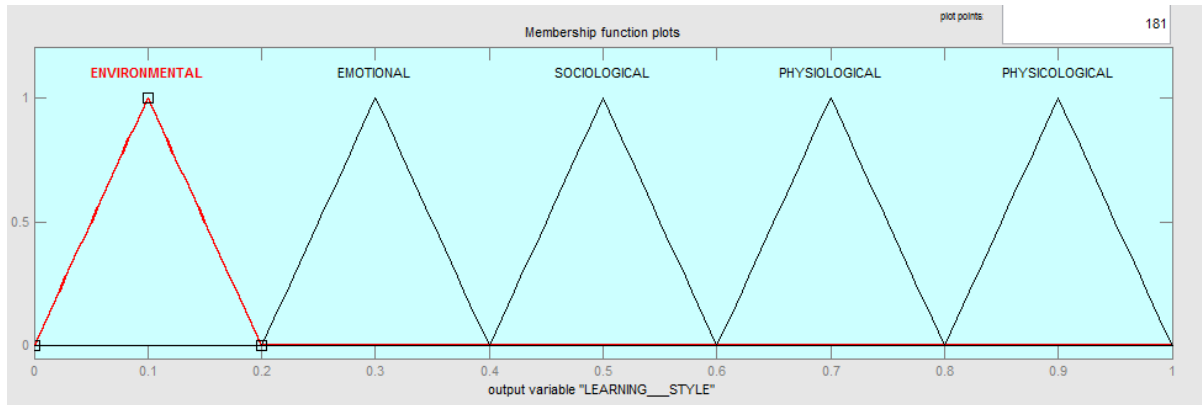

(b)Input for EMOTIONAL

(c)Input for SOCIOLOGICAL

(d)Input for PHYSIOLOGICAL

(e) Input for PSYCHOLOGICAL

(f) Output for LEARNING STYLE

Figure 4. Membership Functions of The Proposed System

The rule base of McCarthy Learning style 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 given below.

IF ENVIRONMENTAL is LOW **AND** EMOTIONAL is HIGH **AND** SOCIOLOGICAL is LOW **AND** PHYSIOLOGICAL is MED AND PSYCHOLOGICAL is MED **THEN** LEARNING STYLES is EMOTIONAL.
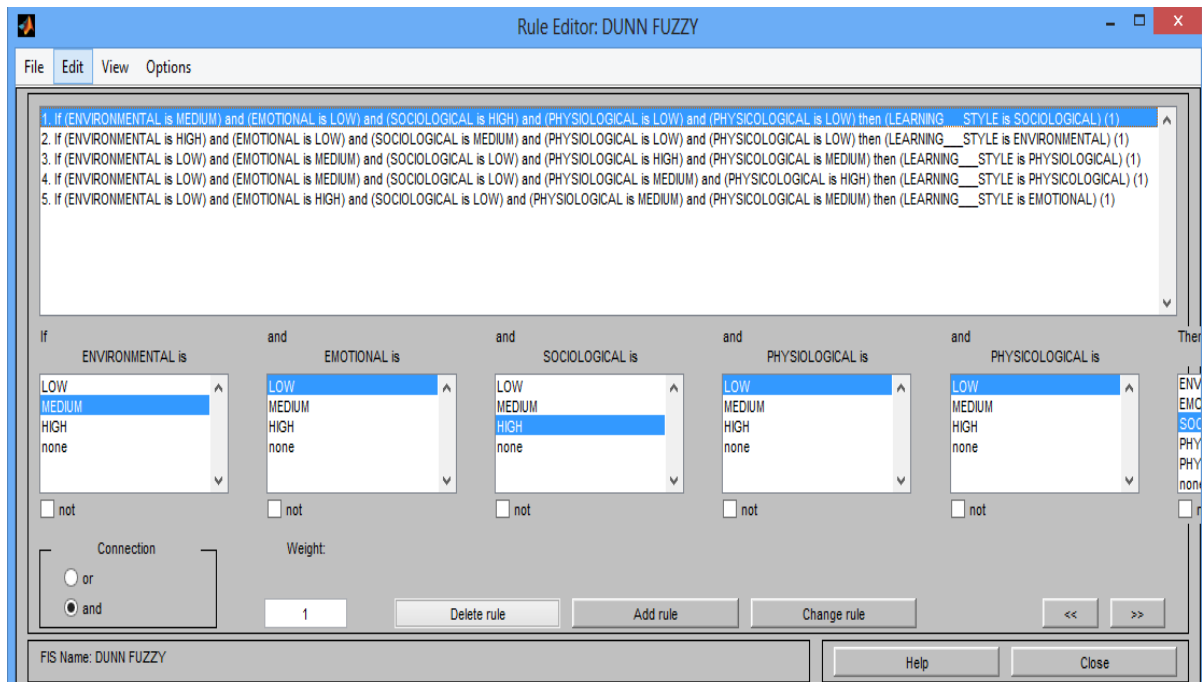

Figure 5. An Example Rule of The Proposed System

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: ENVIRONMENTAL: 5 EMOTIONAL: 11, SOCIOLOGICAL: 6 PHYSIOLOGICAL: 9 PSYCHOLOGICAL: 8 correspond to LOW, HIGH, LOW, MED and MED fuzzy degrees respectively. According to the fuzzy rule "*IF ENVIRONMENTAL is LOW AND EMOTIONAL is HIGH AND SOCIOLOGICAL is LOW AND PHYSIOLOGICAL is MED AND PSYCHOLOGICAL is MED THEN LEARNING STYLES is EMOTIONAL".* The proposed system inferences that, these input values correspond to the value of 0.875 for the learning style crisp output. The Surface Screen Interface of the Proposed Fuzzy Logic Model is shown in Figure 7.
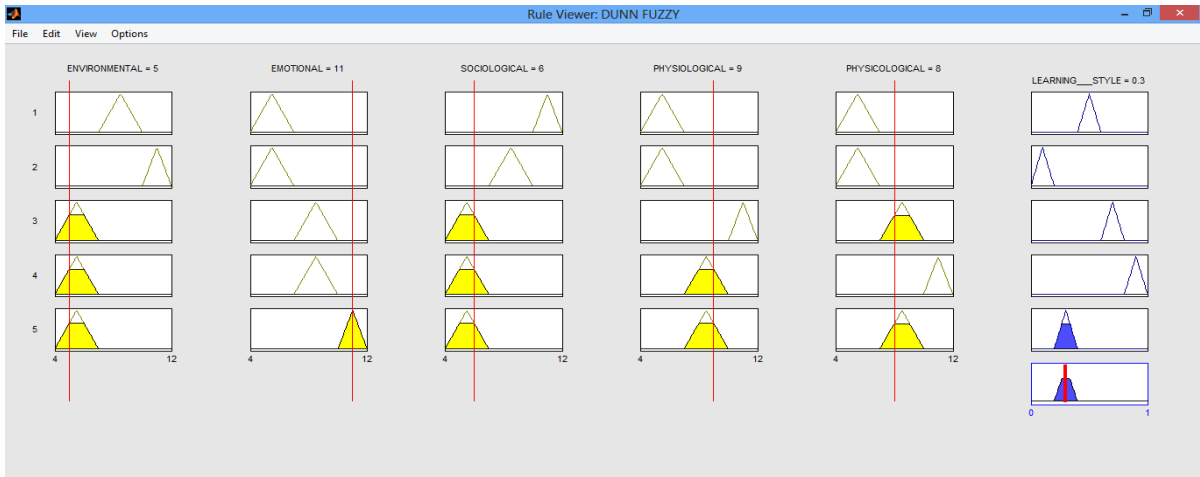

Figure6. An Example Output of the Proposed System
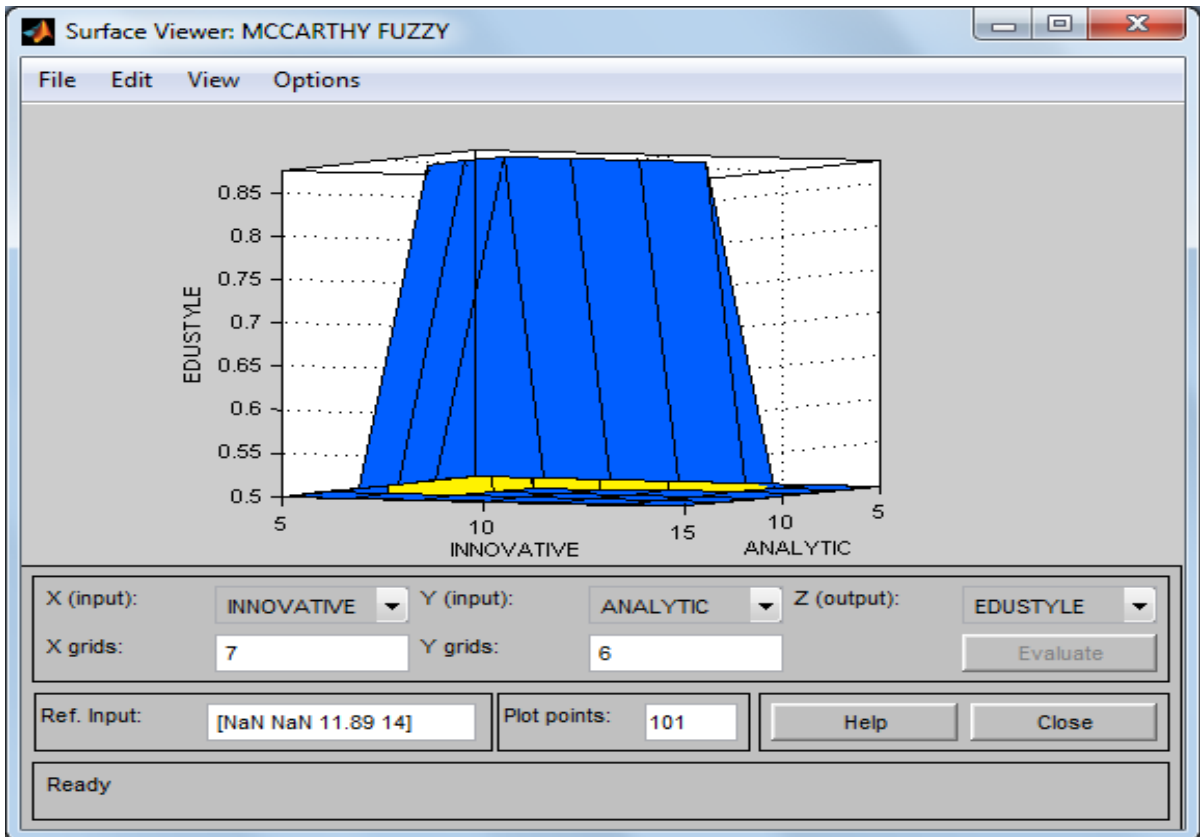

Figure7. The Surface Screen Interface of the Proposed System

CONCLUSION

In this study, fuzzy logic based dunn learning style inference system is developed to measure student's success in learning. The proposed system inferences Education Style, Learning Status and the Level of Learning Style of

the student in accordance with the student's answers to the questions which are presented via software interface. In this study, it is aimed to increase students success in education by deciding most convenient Education style.

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