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FUZZY EXPERT SYSTEM IN DETERMINING HADITH[1] VALIDITY

ABSTRACT: There is a theoretical framework in the Islamic science that helps us to distinguish the valid Hadith from invalid one, named "Hadith science". In addition to Hadith Science, "Rejal science" that concentrates upon the examination of the characters of those who narrated the Hadith. These sciences together can contribute to prove the validity of Hadith. The main objective of this paper is to determine the rate of validity of a Hadith through a fuzzy system with respect to some parameters. According to view point of expert, the data knowledge base has been designed and the essential rules have been extracted. Then the system was implemented by the usage of expert system software's. After that the samples taken from "KAFI[2]" volume 1 were inserted into the data base to be assessed by means of documentary[3] information. The results deduced from our designed expert system were compared with expert view points. The comparison shows that our system was correct in 94% cases.

1. INTRODUCTION

Fuzzy logic is a vast theory consisting fuzzy sets, fuzzy logic, fuzzy measuring and extra. As it is applied at fuzzy logic, fuzzy is implicating some different ambiguity and uncertainty cases. Especially referring to the ambiguity of expressive language and people's thoughts, and it is different with uncertainty which is being expressed by a theory.

Prof. Lotfi Zadeh officially presented an article "Fuzzy sets" at 1965 A.C. Fuzzy logic reached to an inclination point in 1974[2]. Fuzzy was applied to "controlling" by Ebrahim Mamdani for the first time. The international society of fuzzy systems as the first scientific organization was established for fuzzy logic theorists and executors in 1984[5-6].

The first and the most successful function of fuzzy system are "controlling". Fuzzy systems are based on rules or knowledge.

Computing the rules is the first step to design a fuzzy system. The next step is combination of these rules.

Some of the processes of fuzzy sets are: complementary, intersection (minimum) and union (maximum).There are different methods to evaluate a rule; one of them is Mamdani inference following [2]:

$$\mu_{QMM}(X,Y) = \min\left[\mu f_{p1}(x), \mu f_{p2}(y)\right]$$

$$\mu_{QMp}(X,Y) = \left[\mu f_{p1}(x) \times \mu f_{p2}(y)\right]$$

Generalized Modes ponnes deduction might be used as following:

Imagine the fuzzy set "*A′*" and fuzzy relation "*A* → *B*"

At U*V, A fuzzy set *B′* at V is as follow:

$$\mu_{B'}(y) = \sup t \left[\mu A'\ (X, \mu A \to B(X, Y))\right]$$

Fuzzy rules bases: fuzzy rules set will be if → then

When the rule "I" is presented as follow:

RI: If X_1 is A_{i1} and X_2 is A_{i2} …. and X_r is A_{ir} then y is B_i

Fuzzy inference engine: principles of fuzzy logic are applied for rules' combinations. There are 2 different methods for Inference:

1) Inference based on rules' combinations

2) Inference based on singular rules.

At second method, each rule has got a fuzzy result and the final result is combination of those fuzzy results.

Combination is done by union or intersection. Inference engine has got various kinds. One of them is multiplication inference engine which is computed as follow:

$$\mu_{B'}(Y) = \max\left\{\prod{}^r_{K=1} \mu_{Aik}(x'k).\mu_{Bi}(y)\right\}$$

$$i = 10000nR$$

Hadithology is what we are going to discuss about at 2nd chapter. We are also going to talk a bout the criterion and proofs which are confirming the credibility of a Hadith. We'll be having a brief look at sets and components of fuzzy controlling systems at fuzzy systems which are determining the validity of a Hadith [1].

One of the attractive issues at both Shia and Sonni Hadith is paying attention to the sources. Hadith narrators have done their best to know the roots of Hadith meanwhile they are gathering them. One of the branches of Hadith science which is being called "Rejal science" is allocated to this issue and some important books have been written to introduce Hadith narrators [1, 7].

Some people decided to manage some rules and principles to distinguish a true Hadith from a wrong one and the reliable narrator from the liar one because of the wrong Hadith which had been added to the true ones.

Rejal science is considering different aspects of narrator's personality and that's what has got an effect at acceptance or rejections of a Hadith. Rejal science has been attractive for the Moslems since the first days of Islam's appearance and little by little it has been developed. Rejal science has been completed technically since the time Hadith has been widespread [9].

Background of Rejal science is returned to the half of the first century; About 40 A.H. Abid Allah (Abi Rafe'son) Who was Imam Ali's writer (peace be upon Him) Started writing the names of those who were long a long with Imam at Jamal, Safain and Nahrovan wars (Ansar) and those who weren't (Mohajerin) at a book. Sheikh Tosi has reminded the name of the book as ….. "Tasmiye of Martyrs long a long with Imam Ali at wars: safain, Nahrovan and Jamaln"

At Shiite main and the first base of Rejal science is Implicating Imams 'and prophets' praises and reproaches to ward some of their followers. There are so many different Hadith and Hadith books in which Shia's Imams and other honest ones have proved or denied some people because of their views or deeds. Therefore we may take a result the first bases of Rejal science at Shiite innocent Imam's Hadith [9].

2. HADITH APPROVED OR DISAPPROVAL

There are 2 points at Provment or disprovement

1. Provment and disprovement of each narrators

2. Continuous or discrete chain of Hadith

2.1 Different Grades of approved of Narrators

- Most reliable narrators
- More reliable narrators
- Best reliable narrators
- reliable
- . . . .
- Weak
- Very weak

2.2 Different Grades of Disapproval of Narrators

These words like lewd, liar and etc are the words which disapprove a narrator. Another parameter is the religion of the narrator. The last parameter is the number of narrations recited by the narrators.

2.3 Continuous and Discrete of a Hadith

Hadith is being divided into 2 groups from the point of being continuous or discrete

Motasel: there is no time interval between the narrators

Moghuf (absolute Moghuf): Being narrated from Imam's follower. Directly or indirectly and has referred him by a pronoun and source of Hadith is not clear.

Morsal: Hadith has been narrated by the one who have not been during Imam's life.

There are also some other cases which are not as important as others that we are not going to discuss about them at this article.

3. DESIGNING AND IMPLEMENTING PROCESSES

As it was discussed at chapter 2, there are two parameters to determine the validity of a Hadith:

1) Hadith narrator 's honesty and Reliability
2) Continuous and discrete of a Hadith

Table 1
Variables of Group "Inputs"

#	Variable Name	Type	Unit	Min	Max	Default	Term Names
1	Continuity		-	0	4	0	000 MOsnad 001 Moghuf 002 Morsal 003 Abi_omair 004 General
2	Background		Units	0	250	1	mohmal zaeif mamdoh moatabar MOVASAGH
3	Narration_Num		Units	0	130	0	low Medium High
4	Religion		Units	0	100	0.5	CF_L CF_M CF_H

Table 2
Term Names of "Continuity"

Term	Name
000	Mosnad
001	Moghuf
002	Morsal
003	Abi_omair
004	General

Table 3
Definition Points of MBF "Background"

Term Name	Shape/Par.	Definition Points (x, y)		
mohmal	Linear	(0, 0) (150, 0)	(60, 0) (250, 0)	(100, 1)
zaeif	Linear	(0, 1) (250, 0)	(60, 1)	(100, 0)
mamdoh	Linear	(0, 0) (195, 0)	(100, 0) (250, 0)	(150, 1)
moatabar	Linear	(0, 0) (240, 0)	(150, 0) (250, 0)	(195, 1)
MOVASAGH	Linear	(0, 0) (250, 1)	(195, 0)	(240, 1)

Table 4
Definition Points of MBF "Narration_Num"

Term Name	Shape/Par.	Definition Points (x, y)		
low	Linear	(0, 1) (130, 0)	(18.572, 1)	(60, 0)
Medium	Linear	(0, 0) (100, 0)	(20, 0) (130, 0)	(60, 1)
high	Linear	(0, 0) (130, 1)	(60, 0)	(111.426, 1)

Table 5
Definition Points of MBF "Religion"

Term Name	Shape/Par.	Definition Points (x, y)		
CF_L	Linear	(0, 1) (100, 0)	(25, 1)	(50, 0)
CF_M	Linear	(0, 0) (75, 0)	(25, 0) (100, 0)	(50, 1)
CF_H	Linear	(0, 0) (100, 1)	(50, 0)	(75, 1)

Table 6
Term Names of "Hadith_Validity"

Term Name
Unknown
Weak
Goodness
Reliable
Right

Table 7
Term Names of "Narrator_Charact"

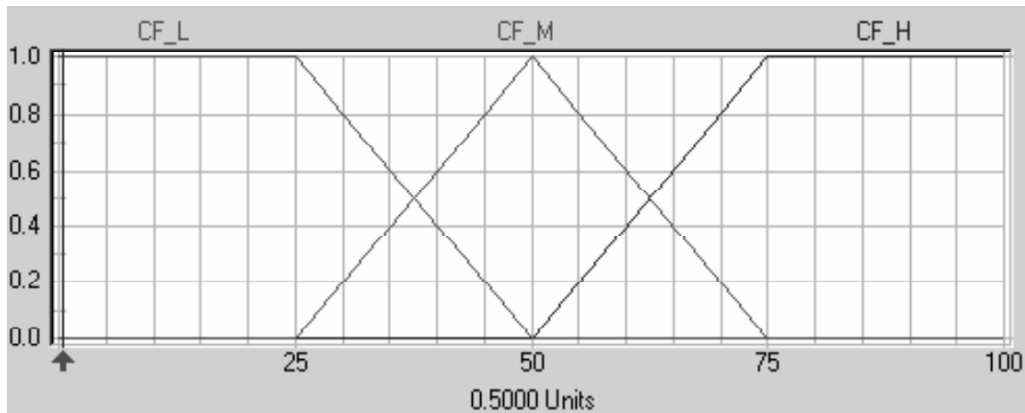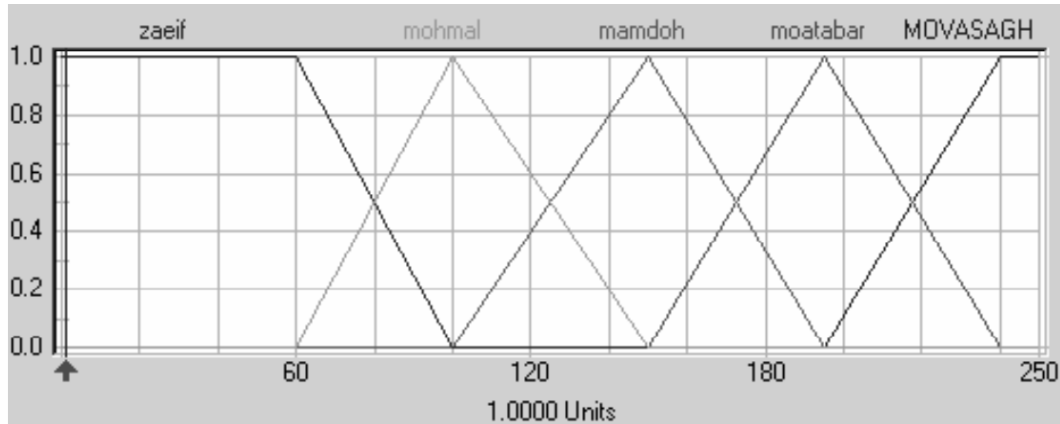| Term Name |
| --- |
| very_low |
| low |
| medium_low |
| medium |
| medium_high |
| high |
| very_high |

Fig. 1: MBF of "Religion"
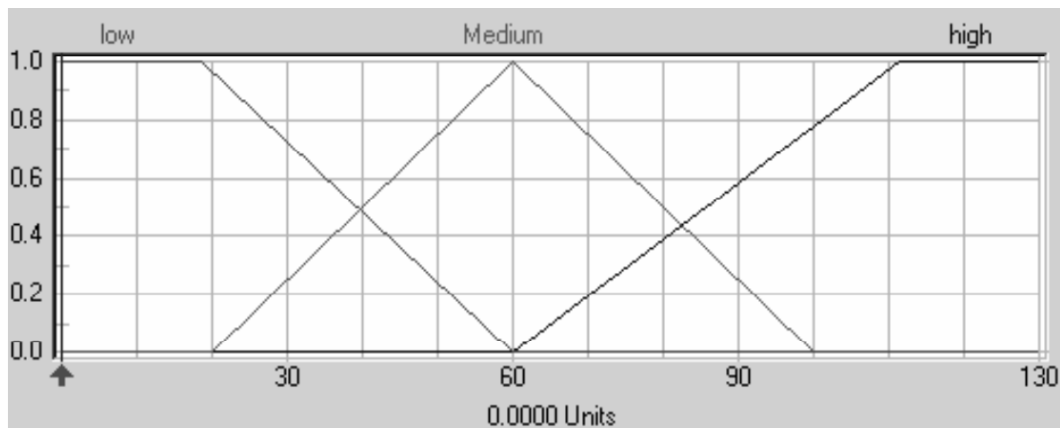
Fig. 2: MBF of "Background"

Fig. 3: MBF of "Narration_Num"

As we know a Hadith has a document. If a narrator in the hierarchy was disapproved the document would automatically be rejected.

Experts grant the qualified degree to narrators. As it was discussed at chapter 1 for creating fuzzy rule base system, the first and important step is to establish a rule's base, therefore we need some rules plus expert's views to make inference.

Two inference engines have done our work and get the result the output of the first engine is the Rank of each narrator and it will be an input for the second inference engine. The output of the second engine is Hadith validation rate. We divide our system in rules in two blokes. First rule blokes focus on the personal characteristics of narrator and the second rule blocks concentrate on Hadith.
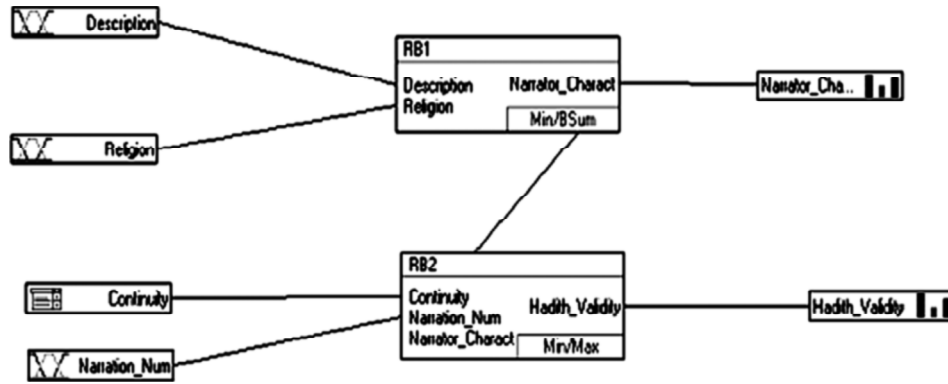
Fig. 4: Structure of the Fuzzy Logic System

Table 8
Variables of Group "Outputs"

#	Variable Name	Type	Unit	Min	Max	Default	Term Names
5	Hadith_Validity		—	—	—	—	unknown
							Weak
							Goodness
							Reliable
							Right
6	Narrator_Charact		—	—	—	—	very_low
							low
							medium_low
							medium
							medium_high
							high
							very_high

Narrators have been given 5 degrees based on their background and 3 degrees based on their religion. The combination of background and religion degree gives 15 statuses.

Table 9
Rule Block "RB1"

Aggregation:	MINMAX
Result Aggregation:	MAX
Number of Inputs:	2
Number of Outputs:	1
Number of Rules:	13

Table 10

Rules of the Rule Block "RB1"

IF		THEN	
Background	Religion	DoS	Narrator_Charact
MOVASAGH	CF_H	1.00	very_high
MOVASAGH	CF_M	0.70	very_high
MOVASAGH	CF_L	0.50	very_high
Moatabar	CF_H	0.90	High
Moatabar	CF_M	1.00	medium_high
Moatabar	CF_L	0.80	medium
Mamdoh	CF_H	0.90	medium_high
Mamdoh	CF_M	0.60	medium
Mamdoh	CF_L	0.90	medium_low
Mohmal	CF_H	0.50	medium_low
Mohmal	CF_M	0.30	Low
Mohmal	CF_L	0.80	very_low
Zaeif		1.00	very_low

The second inference engine has 3 inputs, one input is the output of first engine and the others are number of narration and continuity chain of Hadith that is shown in table 2.

Table 11

Rule Block "RB2"

Aggregation:	MINMAX
Result Aggregation:	MAX
Number of Inputs:	3
Number of Outputs:	1
Number of Rules:	36

Second step is fuzzification of the variables. Triangular fuzzifier is used for the eligibility degree and singleton fuzzifier is used for the time interval. At the third step the inference engine has been applied. Inference engine helps us to process the input data by means of rule base to make suitable output.

Multiplication inference engine is applied to simplify our computation.

Therefore the following methods are used [3]:

A) inference based on separated rules plus union combination

B) Mamdani multiplication inference

C) Algebra multiplication for fuzzy intersection

D) Maximum for fuzzy union which is being computed as follow :

$$\mu_{B'}(Y) = \max\left\{\prod_{k=1}^{r} \mu_{Aik}(x'k).\mu_{Bi}(y)\right\}$$

$$I = 1\ldots,n_R$$

through having a fuzzy set *A'* at U, the above Formula (multiplication inference engine) will be resulted a fuzzy set *B'* at *V*.

Last step is de fuzzifier designing. We use center Average Defuzzifier according to logic of the problem and criteria to choose Defuzzifier Center Average Defuzzifier is one of the most common and current methods at fuzzy systems and their controlling.

Output is at an exact and definite point ($y' \in v$) as follow [5]:

Table 12
Rules of the Rule Block "RB2"

IF			THEN	
Continuity	*Narration_Num*	*Narrator_Charact*	*DoS*	*Hadith_Validity*
Mosnad	High	very_high	1.00	Right
Mosnad	Medium	very_high	0.90	Right
Mosnad	Low	very_high	0.80	Right
General			1.00	Weak
Moghuf			1.00	Unknown
Abi_omair	High	very_high	0.90	Right
Abi_omair	Medium	very_high	0.80	Right
Abi_omair	Low	very_high	0.70	Right
Mosnad	High	High	1.00	Reliable
Mosnad	Medium	High	0.90	Reliable
Mosnad	Low	High	0.80	Reliable
Abi_omair	High	High	0.90	Reliable
Abi_omair	Medium	High	0.80	Reliable
Abi_omair	Low	High	0.70	Reliable
Mosnad	High	Medium_high	0.60	Reliable
Mosnad	Medium	Medium_high	1.00	Goodness
Mosnad	Low	Medium_high	0.90	Goodness
Abi_omair	High	Medium_high	0.50	Reliable
Abi_omair	Medium	Medium_high	0.90	Goodness
Abi_omair	Low	Medium_high	0.80	Goodness
Mosnad	High	Medium	0.70	Goodness
Mosnad	Medium	Medium	0.60	Goodness
Mosnad	Low	Medium	0.50	Goodness
Abi_omair	High	Medium	0.60	Goodness
Abi_omair	Medium	Medium	0.50	Goodness
Abi_omair	Low	Medium	0.40	Goodness
Mosnad	High	Medium_low	0.60	Goodness
Mosnad	Medium	Medium_low	1.00	Weak
Mosnad	Low	Medium_low	1.00	Weak
Abi_omair	High	Medium_low	0.50	Goodness
Abi_omair	Medium	Medium_low	1.00	Weak
Abi_omair	Low	Medium_low	1.00	Weak
Mosnad		Low	0.60	Weak
Mosnad		very_low	0.90	Weak
Abi_omair		Low	0.70	Weak
Abi_omair		very_low	1.00	Weak

$$y' = \frac{\sum\limits_{i=1}^{nR} Y_0^{(i)} . w^{(i)}}{\sum\limits_{i=1}^{nR} w^{(i)}}$$

$w^{(i)}$ Is height degree, therefore our out put (y')is our final out put or in other word Validity degree of a Hadith.

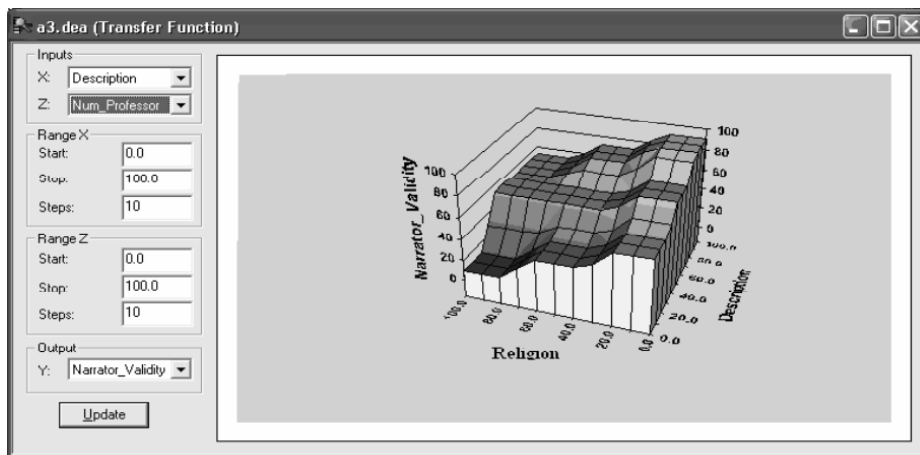Figures 5-7 shows the effect of parameters on outputs graphically.

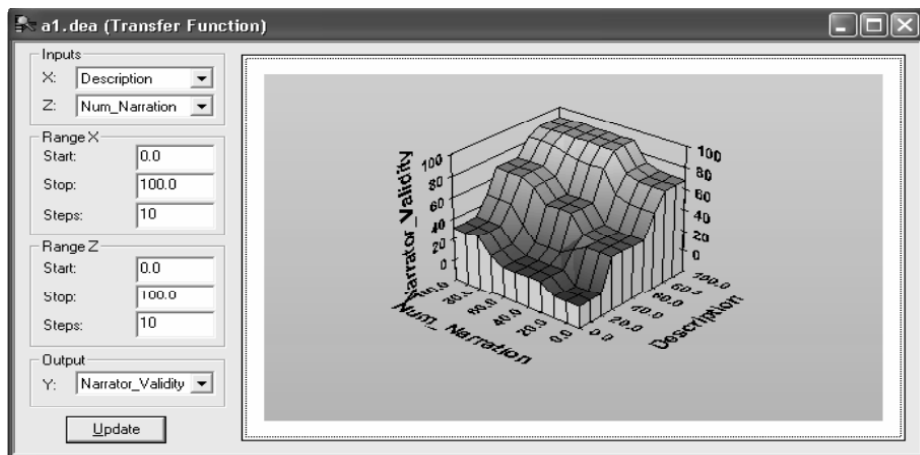**Fig. 5: Effect of Background and Religion on Narrator validity**

Fig. 6: Effect of Background and Number of narration on Narrator validity
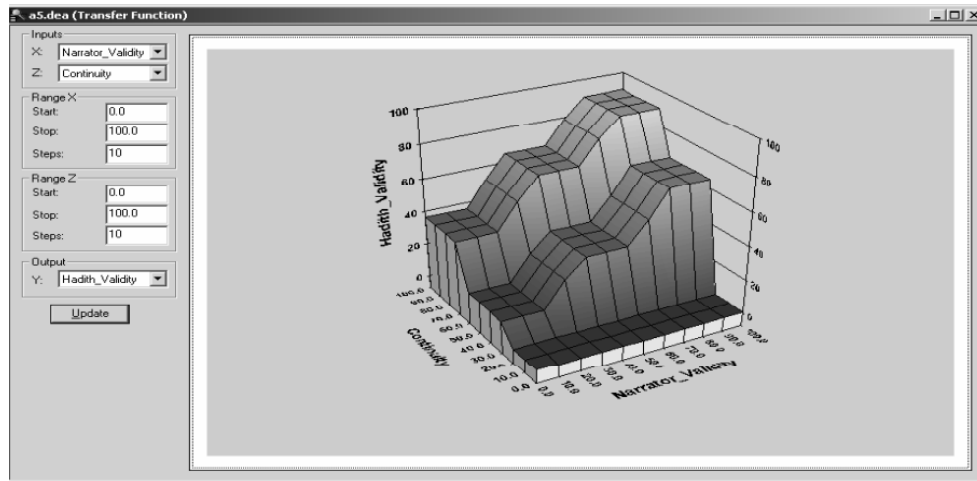
Fig. 7: Effect of Narrator validity and Continuity on Hadith validity

Example

Suppose A, B, C, D, E, F and G are 7 narrators. Following are qualifications of these narrators:

Table 13
Narrator Characteristic

NO	Narrator's Name	Background	Religion CF	Number of Narration
1	A	Movasagh	56	20
2	B	Zaeif	23	17
3	C	Mohmal	45	67
4	D	Moatabar	48	54
5	E	Mohmal	32	35
6	F	Movasagh	56	76
7	G	Moatabar	34	93

Assume that A, C, E are chain of one Hadith and B, D, F, G are chain of second Hadith. If First Hadith continuity was Moghuf and the Second one was Mosnad (Motasel) following is the result of our system that determine state validity of Hadith:

1. The validity of Hadith is "Unknown".

2. The validity of Hadith is "Very Low"

We implement this system in First volume of kaffi book that contains more than 1900 Hadith and 4000 narrators. By doing simple query on the outputs the following results will be gained:

Systems output is correct in 94% cases. It means system has only errors in 6% cases.

4. CONCLUSION

Fuzzy logic has a great scope and it can be used for different purpose. Islamic sciences can make use of it. We can also benefit from the concept s of its logic in Islamic sciences such as Hadith science.

We concluded we can use the expert's experiences and implements them in form of IF-then Rules. The final out put will be shown in fuzzy set. We are able to show the result digit through using defuzzifier. As reoffered before the system accuracy is very high and we can claim that if all the rules enter the system correctly and completely the system will be worked without any errors. Quick inference and rapid computing of the outputs are the other characteristics of this system. The system is also flexible because the rules are changeable.

NOTES

[1]   Hadith is a narration from Holly Prophet of Islam or Imams.

[2]   KAFI is one of the most reliable reference books of Hadith in Islam.

[3]   Document includes a set of narrators that have been arranged in hierarchy.

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