Fabricated and Shia Malay Translated Hadith as Negative Fuzzy Logic Ranking Indicator on Malay Information Retrieval

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The ranking function is a predictive algorithm that is used to establish a simple ordering of documents according to its relevance. This step is critical because the results' quality of an IR System is fundamentally dependent on the ranking. This paper aims to develop the Fuzzy Logic Controller of Mamdani-type Fuzzy Inference System to define the ranking function, based on the Malay Information retrieval's BM25 Model. The logic controller also includes Fabricated and Shia Malay Translated Hadith as the negative ranking indicator to demote the negative document to the bottom of the ranking retrieval results. The results then are evaluated by referring to the relevant documents issued by the Hadith experts and compared with the results produced by the BM25 model original score and the Vector Space Model. Based on the experiment's result and evaluation, the proposed system has slightly outperformed the BM25 original score and the *Vector Space Model (VM)* on 11 queries, while the BM25 original score and Vector Space Model only yield a better result in five and eight queries respectively on the P@10, %no measures and *MAP*. Hence, proven the proposed system has a potential for further research to be conducted on these domains.

Keywords: fuzzy logic; Malay text corpus; Malay translated hadith; fabricated and Shia hadith; BM25 negative ranking indicator

I. INTRODUCTION

Ricardo *et al.* (2011) define the ranking process as the most important aspect. The process shows the effectiveness and accuracy of Information Retrieval (IR). The ranking function acts as a predictive algorithm that is used to establish a simple ordering of documents according to its relevance. The result's quality on an IR System is fundamentally dependent on the ranking (Ricardo *et al.*, 2011). BM25 Model is an extension of the Probabilistic model. A probabilistic model is one of the Classic IR models. Contrary to the original conceptions of the classic probabilistic model, the BM25 Model can be computed without any relevant information provided by the user (Ricardo *et al.*, 2011). According to Ricardo *et al.* (2011),

Vector Space Model is one of the classic IR models that is simple, fast, providing good and sound basic ranking functions especially when it is used in general collections. Hence, it is commonly used as a baseline in the evaluation of alternative ranking formulas or the newly proposed IR models. IR also has a contribution in the innovation of education technology especially in providing and recommend relevant information to the student and instructor, that we can see in the works of Meisalo *et al.* (2004) and Zeng Y *et al.* (2017).

According to Rouben *et al.* (2006), Fuzzy logic is a logical system and an extension of multi-valued logic. It is an alternative for the Boolean Logic. The usage of fuzzy logic provides the benefits of the Boolean method. While

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overcoming its drawbacks, it has a credibility to be applied in any retrieval model that has its own defined rules and allow access to its inside specification (Rouben *et al.*, 2006). According to Azmi & AlOfaidly (2014), the role of the hadith as a source of Islamic teaching has been agreed upon by almost all sects and heavily searched by the Muslims around the world as their source of religious knowledge and education. The Muslims believe Hadith is the second source of documented Islamic knowledge after the Quran. Hadiths are the collection of words, affirmation and character of the Prophet Muhammad (PBUH) recorded and documented by the Prophets' followers as the interpretation of the Qur'an. However, Shia sects have a different view on the matter, Imamiyah for example, believe that the words of the imam of Ahlu al-Bait are also equivalent to the words of the Prophet (PBUH). Therefore, the hadiths in their terms also include the words, deeds or ordinances of their Imams (Azmi & AlOfaidly, 2014). Majority of the prominent Muslim scholars have concluded that the most reliable and authentic collection are the books from Sahih Bukhari and Sahih Muslim. As for Shia, they have four primary books of hadiths such as al-Kafi, by Abu Ja'far Muhammad bin Ya'qub al-Kulaini, al-Istibshar, and al-Tahdzib, both are by Muhammad bin Hasan al -Thusi and Man La Yahdhuru al-Faqih, by Muhammad Babawaih al-Qarni (Azmi & AlOfaidly, 2014).

A. Problem Statements

According to Ayub (2018):

> Unlike the al-Qur'an, not all hadiths are authentic; the fake or forged hadith is called *Fabricated (Maudu') Hadith*. Due to the widespread of *Fabricated (Maudu') Hadith*, Muslim scholars have developed the method to determine authentic hadiths from the forged ones. The method is called 'ulūm al-ḥadīth. It consists of *isnād* (chain of the narrator) and *matn* (content of hadith) criticism. Traditional 'ulūm al-ḥadīth is criticized by Morden Islamic scholars for it cares only *about isnād* and put less emphasis on *matn*. It has been proven that *matn* criticism also played an important role in hadith authentication. The role of matn criticism is to find the 'illah (flaws) and shādh (irregular)in the *matn*.

In regard with the statement, the researchers found a Fatwa (Fatwa is a scholarly opinion on a matter of Islamic law) issued by National Fatwa Council of Malaysia establishing that Muslims in Malaysia should only follow Islamic teachings based on the Ahli Sunnah Wal-Jamaah in terms of "aqidah, syari'ah and akhlaq (JAKIM, 1997). Since both fabricated and Shia hadiths are not included in Ahli Sunnah Wal Jamaah documents, thus those two documents will not be a resource for any decision on Ahli Sunnah Wal Jamaah. Therefore, it is enough reason to demote these documents from the ranking result of hadith retrieval, especially in Malaysia. To add to the list of demotion, according to Ibnu Qayyim Ibn Qayyim al-Jawziyah (2015), Shia (Ar-Rafidah) Hadiths especially those were narrated about Khalifah Ali bin Abi Talid are also included in the domain of fabricated hadith. Regarding the Information Retrieval domain, according to SB bin Rodzman *et al.* (2017), although there were several researches done to improve the retrieval of the Malay document, there are still limited researches done on optimizing or improving the ranking using the application of Fuzzy Logic in Malay Information Retrieval.

B. Research Objectives

Based on the above statements, the objectives of this research are: 1) To identify the factors affecting the ranking of relevant Malay documents retrieval or searching results such as Fuzzy Logic Controller. 2) To develop the Fuzzy Logic Controller of Mamdani-type called Fuzzy Inference System to define the ranking function based on the BM25 Model in the Malay Information Retrieval that includes Fabrication Rate of Hadith and Shia Rate of Hadith as the negative ranking indicator. The rules that involve in the calculation on both of these rates are derived from unique features such as a name from *isnad* (chain of the narrator), unique terms from *matn* (the content of hadith) and also top 10 frequency terms from each hadith in the corpus that consists of 160 *Malay Translated Fabricated Hadith* text documents that were obtained from Malay translated book of Al-Manar al-Munif Fi al-Sahih wa-al-Dhoif by Ibn Qayyim al-Jawziyah (2015) and the 270 Malay Translated Shia Hadiths that were taken out from Kitab Al-Khafi Usul and Raudah. 3) To evaluate the effectiveness of overall implementation by comparing the result of the ranking functions with the result of BM25 Model original score and *Vector Space Model* that is also applied in *Malay IR System*. The evaluation is done by referring to the relevant documents issued from Hadith experts and by using

the evaluation metric such as *Precision at Rank 10* (P@10) and MAP. Precision at Rank 10 (P@10) represents the percentage of the query with no relevant document in the top ten retrieved (%no) and MAP represents Mean Average Precision of the Query.

II. RELATED WORK

This paper analyses the researches that implement Fuzzy Logic to define the Ranking Function and Information Retrieval, Mamdani-Type FIS and the field related to Fabricated Hadith and The Authentication of Hadiths.

A. Fuzzy Logic in defining Ranking Function and Information Retrieval

Fuzzy logic was applied in a variety of researches and according to the research review, it consistently produces better results due to its capability in dealing with uncertainty and vagueness. For example, Alzahrani *et al.* (2009) presented a Fuzzy technique to measure the similarity of two Arabic documents, Zhou *et al.* (2009) proposed a Fuzzy content-based approach for determining webpage duplications, and Olufade *et al.* (2010) presented a Fuzzy String-Matching model and Comfort *et al.* (2011) presented a fuzzy-ontology based information retrieval. Fuzzy Logic also shows the potential in improving the results of IR ranking function. As an example, Rouben *et al.* (2006) used *Fuzzy Logic* (FL) to define the ranking function of *Vector Space Model* and found that *Fuzzy Logic* provides easiness for the ranking function to be viewed and extended to the new formula with *Mamdani Type Rules*. Salha *et al.* (2009) discussed the process of determining the similarity in the *Fuzzy IR Model* that will contribute lastly in the ranking function. The results show that *Fuzzy IR* is good in finding more relevant documents that contain a similar term with words that have different meaning and *can* be implemented to determine the similarity of the documents. Lubna *et al.* (2011) tried to improve the IR ranking function by extending earlier Rouben *et al.* (2006) models by adding more fuzzy linguistic values such as fuzzy variables and using different membership functions. The results showed the increased performance in term of precision of the suggested model to 4.7%. Yogesh Gupta *et al.* (2016) also tried to improve the Rouben *et al.* (2006) work by producing one composite fuzzy-based ranking function and Two fuzzy-based hybrid

similarity measures. The result shows that the composite fuzzy-based ranking function performed better in improving the ranking function score. Jagendra *et al.* (2016) proposed a novel fuzzy logic-based expansion approach. The relevance score produced will be considered by different rank aggregation approaches. The proposed fuzzy logic approach combines the different weights of each term by using the fuzzy rules to infer the weights of the additional query terms. The results showed a significant improvement compared to other related methods.

B. Mamdani Type FIS Fuzzy Logic in defining Ranking Function and Information Retrieval

According to Ark Andreev *et al.* (2015), Mamdani-Type model of Fuzzy Inference System is widely accepted for capturing expert knowledge. It allows the description of the expertise in a more intuitive and more human-like manner.

C. Fabricated Hadith and the Authentication of Hadiths

The literature of hadith always focuses on the authentication of the hadith, the classification of the Hadith, the language of the Hadith and the information extracted from the hadith. Due to its objective to bring the best outcome for the user, many researches are still under the implementation phase, in a way to find the new aspect of improvement in this research area. As an example, Ghazizadeh *et al.* (2008) used the Fuzzy expert system to classify and determine the rate of the validity of the Hadith. Hadith classification in various techniques also have been done such as in H.M Alrazo (2004), Kawtheer *et al.* (2009), Yusoff *et al.* (2010) and Shatnawi *et al.* (2012), their works mostly focused on the authentication of Hadith. Same as Najeeb *et al.* (2015) that suggested a method for Hadith Isnad (chain narrator), Baraka *et al.* (2014) built a domain-specific ontology (Hadith Isnad Ontology) to support the process of authenticating/judging Isnad. Azmi *et al.* (2014) proposed algorithm and model for a system that judges a Hadith to one of three categories: sahih, hasan, and da'if b using a simple scheme and modelled the rules using 50 sample Hadiths from Sunan al-Tirmizi. The system was evaluated using 2900 Hadiths from Sunan al-Tirmizi and Sahih of Bukhari and yielded the success rate of 94% for Sunan al-Tirmizi and over 99% for Sahih of Bukhari.

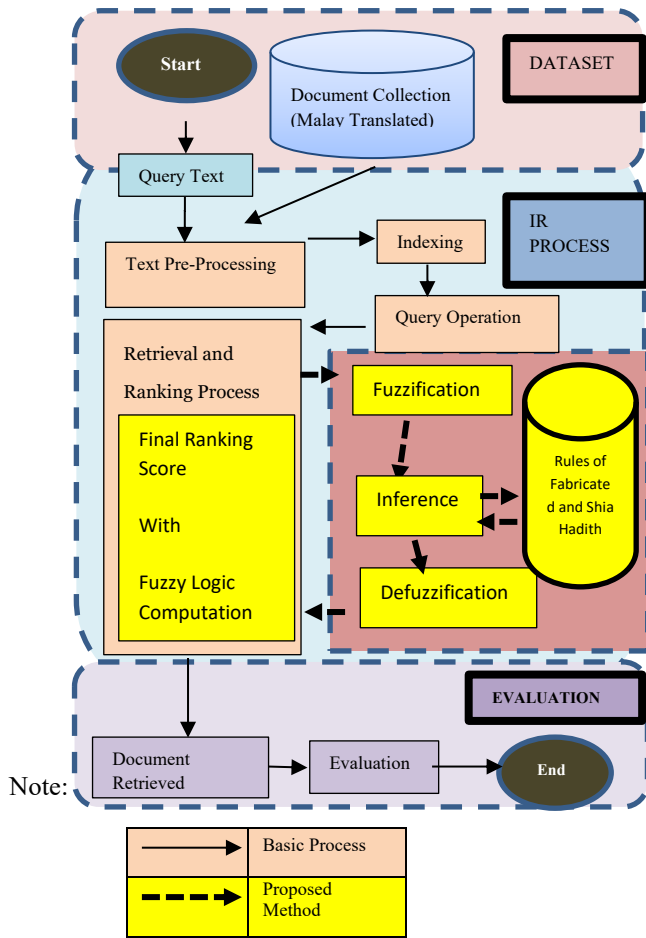## III. RESEARCH METHOD

A. Framework

Figure 1. Conceptual Framework of FBMIR

The framework of the *Fuzzy BM25 Malay Information Retrieval System (FBMIR)* that illustrated in Figure 1, features a fuzzy inference system that improves the score of the ranking function of the BM25 by using *Fuzzy Processing* called *Fuzzification*, *Inference*, and *Defuzzification* to yield the result. It also includes Fabrication Rate of Hadith and Shia Rate of Hadith as the negative ranking indicator. The results then will be evaluated by comparing them with the results that were yielded from BM25 original score and *Vector Model Malay IR System (VM)*.

B. The System

1. Fundamental

1) Model for Modification: Fuzzy Logic is credible to be applied in any retrieval model that possesses its own defined

rules and allows access to its internal specification. In this system, the BM25 model will be used as the original score or as input for Fuzzy Processing. The reasoning is the BM25 Model has proven that it yields the best results in general collections compares to the Vector Space Model. BM25 Model is widely used for evaluating the new ranking method as a baseline model, in substitution to the vector model (Ricardo *et al.*, 2011).

2) Ranking Function: The system will apply a fuzzy inference system to improve the ranking function by using BM25 Model. The equation 1.1. as follows shows, *While Q is* the Query that consists the keywords of q1 until qn, the Score of BM25, *D* will be as:

$$score(D,Q) = \sum_{i=1}^{n} IDF(q_i) \cdot \left(\frac{f(q_i,D) \cdot (k_1+1)}{f(q_i,D)+k_1 \cdot \left(1-b=b \cdot \frac{|D|}{avgdl}\right)} \right) (1.1)$$

$$\text{BM25 Ranking Score} = \frac{score(D,Q)}{Max(score(D,Q))} \times 100 \quad (1.2)$$

where *Max* is a *Maximum Score of Documents for a given query.*

2. Proposed Fuzzy Model

The ranking score is then involved in Fuzzy Processing, which is the main technique that includes processes such as Fuzzification, Inference and Defuzzification to yield the result. The result will then be evaluated by comparing it with the result that was yielded from the BM25 original score and Vector Space Model Malay Information System (VM). In this research, the researchers use fuzzy inference technique of Mamdani method. The technique involves five steps such as:

Fuzzification: The process in which the mathematical meaning of the linguistic variables will be defined. The model examines three-inputs (BM25 Ranking Score, Fabrication Rate of Hadith and Shia Rate of Hadith) and four-output values of Final Score Ranking which consist of three triangular membership functions. The three crisp input variables are BM25 Ranking Score, Fabrication Rate of Hadith and Shia Rate of Hadith. The variables and range of possible value are determined by expert judgments. Linguistic variable consists of (Final Ranking Score), and three attributes (BM25 Ranking Score, Fabrication Rate of Hadith and Shia Rate of CHadith). Four-output variables and 10 of input variable are identified and evaluated by the domain expert. The BM25 Ranking Score has been determined by using the formula as in equation 1.2.

1. If the BM25 Ranking Score is Low (L): BM25 Ranking Score <= 40
2. If the BM25 Ranking Score is Medium (M): 20 < BM25 Ranking Score <= 60
3. If the BM25 Ranking Score is High(H): 40< BM25 Ranking Score <= 80
4. If the BM25 Ranking Score is Very High (VH) >= 60

For distribution of Fabrication Rate of Hadith or Shia Rate of Hadith, a range between 0-1 is determined according to the highest percentage of unique features of Fabricated Hadith or Shia Rate of Hadith that appear in the particular Hadith document and using the formula in equation 1.3 as below:

Fabrication Rate of Hadith or Shia Rate of Hadith =

$$= \frac{a(r_i, R)}{r_n} \qquad (1.3)$$

where $a(r_i, R)$ is the total *Unique Features that Appeared in each Document* and r_n *is the Total Unique Features.*

1. If the Fabrication Rate of Hadith or Shia Rate of Hadith **is** Low(L): Fabrication Rate of Hadith or Shia Rate of Hadith <=0.6
2. If the Fabrication Rate of Hadith or Shia Rate of Hadith is Medium(M): 0.3< Fabrication Rate of Hadith or Shia Rate of Hadith <= 0.8
3. If the Fabrication Rate of Hadith or Shia Rate of Hadith is High(H): Fabrication Rate of Hadith or Shia Rate of Hadith >= 0.6

The output of this Fuzzy Logic Controller will be in the range as below:

1. If the Final Ranking Score is Zero: BM25 Ranking Score <= 40
2. If the Final Ranking Score is Low: 20 < BM25 Ranking Score <= 60
3. If the Final Ranking Score is High 40< BM25 Ranking Score <= 80
4. If the Final Ranking Score is Very High >= 60

Inference: The Fuzzy Inference Process is performed right after the Fuzzification process. Each of the steps will be examined in every single value inside the fuzzy set to give out the value for the variable of the fuzzy set.

Defuzzification: The scores from the fuzzy set will serve as the input for the Defuzzification process. It will then be calculated to produce the single-digit score according to Rouben *et al.* (2006) by using the widely used centre of area (COA) Defuzzification method for the computation of the final score of the ranking function.

Hierarchical Fuzzy Logic System: In this paper, we applied the design of a hierarchical fuzzy logic system that has a potential to reduce the number of fuzzy rules in the system thereby reducing Fuzzy Knowledge Base (FKB) of the fuzzy logic systems and reducing the computational time while maintaining the systems robustness and efficiency (Masoud, 2017). The researchers have run the Fuzzy Logic Controller (FLC1) of Mamdani Method, with two inputs such as BM25 Ranking Score and Fabrication Rate of Hadith that produce the output of FLC1, the output of FLC1 will be the input of FLC2 along with Shia Rate of Hadith and that will produce the Final Ranking Score of the document as we can see in Figure 2 such as below.
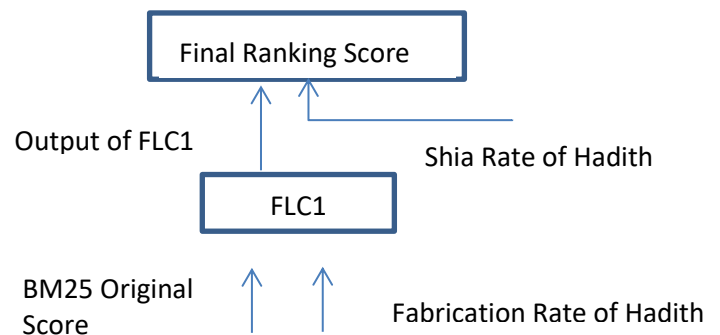

Figure 2. Hierarchical fuzzy logic controller of FBMIR

Rules: To initiate the Fuzzy Processing, the conversion of the knowledge on the IR system and as well as the ranking score in BM25 need to be defined as the rule. The rule base will apply the Mamdani Type Rules of Fuzzy Logic. This takes two attributes for each Fuzzy Logic Controller, which is the BM25 ranking score and Fabrication Rate of Hadith for Fuzzy Logic Controller 1 (FLC1) and, the output of FLC1 and Shia Rate of Hadith for Fuzzy Logic Controller 2 (FLC2) as we can see in Table 1.

Table 1. List of Rules

Case	Rules	Final Ranking Score
1	if BM25= or FLC1 = L &Fabrication or Shia= H	Zero
2	if BM25 or FLC1 = M &Fabrication Shia= H	Zero
3	if BM25 or FLC1 = H &Fabrication or Shia= H	Zero
4	if BM25 or FLC1 = VH &Fabrication or Shia= H	Zero
5	if BM25 or FLC1 = L &Fabrication or Shia= M	Zero
6	if BM25 or FLC1 = M &Fabrication or Shia= M	Low
7	if BM25 or FLC1 = H &Fabrication or Shia= M	Low
8	if BM25 or FLC1 = VH &Fabrication or Shia=M	Low
9	if BM25 or FLC1 = L &Fabrication or Shia= L	Zero
10	if BM25 or FLC1 = M &Fabrication or Shia= L	Low
11	if BM25 or FLC1 = H &Fabrication or Shia= L	High
12	if BM25 or FLC1 = VH &Fabrication or Shia= L	Very High

IV. RESULT AND DISCUSSION

A. Performance Evaluation

The experiments were conducted by using the Malay corpus consist of 2026 *Malay Translated of Sahih Bukhari Hadiths* text document, 160 *Malay Translated Fabricated Hadiths* text document that was obtained from the Malay translated book of Al-Manar al-Munif Fi al-Sahih wa-al-Dhoif by Ibnu Qayyim Ibn Qayyim al-Jawziyah (2015) and 1,270 Malay

Translated Shia Hadiths that were taken out from the Kitab Al-Khafi Usul and Raudah. The researchers used 30 total queries from eight topics for the experiments. The topic under 'Umum' has a total of 11 queries, while other seven topics have around two to four queries with an average three queries for each topic (N.A. Rahman *et al.,* 2010). The relevance of the documents was determined by two *Hadith experts,* Dr Zulhilmi bin Mohamed Nor from Universiti Sains Islam Malaysia and Dr Ahmad Yunus Mohd Noor from Universiti Kebangsaan Malaysia. The Values *Precision at Rank 10* (P@10), the percentage of the query with no relevant document in the top ten retrieved (%no) and *AP* represent *Average Precision* of the *Query* have been calculated in this evaluation. The results are shown in Table 2 below.

Table 2. List of Topic Results

No	TOPIC	FBMIR P@10	BM25 P@10	Vector P@10	FBMIR %no	BM25 %no	Vector %no	FBMIR MAP	BM25 MAP	Vector MAP
1	Makanan	0.566	0.8	0.47	43.4	20	53.4	0.580	0.824	0.502
2	Adab	1	1	0.75	0	0	25	1	1	0.715
3	Solat	0.396	0.476	0.58	40.4	52.4	42	0.547	0.486	0.584
4	Iman	0.542	0.466	0.44	45.8	53.4	55.6	0.564	0.463	0.565
5	Bersuci	0.85	0.937	0.51	15	6.3	48.7	0.809	0.968	0.534
6	Ibadah	0.493	0.35	0.54	50.7	65	45.9	0.505	0.328	0.577
7	Sirah	0.727	0.733	0.73	27.3	26.7	26.7	0.919	0.830	0.905
8	Umum	0.429	0.333	0.35	57.1	66.7	74.7	0.509	0.338	0.392

Based on the experiments' results that are illustrated in Table 2, *FBMIR's* result slightly outperforms BM25 original score and *Vector Space Model (VM)* on two topics set of query results such as *"Adab"* and *"Umum"* on the P@10 and %no measures. It also outperforms BM25 original score and Vector Space Model (VM) MAP result on three topics, which are *"Adab"* and *"Umum"* and *"Sirah".* P@10 represent the values of *Precision at Rank 10* P@10), %no measures represent the percentage of queries with no relevant documents in the top ten retrieved and *MAP* represents Mean Average Precision of the queries. Vector model just slightly outperformed *FBMIR* for all results on the P@10, %no measures and *MAP* for the topics of *"Ibadah"* and two topics for P@10 and MAP alone. BM25 original score has outperformed *FBMIR* for all results on the P@10, %no measures and *MAP* in the topic set of *"Makanan","Iman"* and

"Bersuci" and BM25 also outperformed *FBMIR* in five topics such as "*Makanan*", "*Solat*", "*Iman*", "*Bersuci*" and "*Sirah*" on the P@10 results. Even though *FBMIR* only produced the best result in two topics, but overall, the *FBMIR* has outperformed the other two models in term of individual query results. Out of the 30 queries, *FBMIR* has yielded better result in 11 queries compared to BM25 original score and Vector Space Model. Both only yielded better result in five and eight queries respectively. If we compare the results of *FBMIR* directly with BM25 Original Score, *FBMIR* has outperformed BM25 Original Score in 13 queries for the results of all on the P@10, %no measures and *MAP*. *FBMIR* also outperformed BM25 Original score in 16 queries on *MAP* results alone. These results show that the application of membership function in fuzzy logic approach and as well as the input of Fabricated and Shia Rate of Hadith as Negative Fuzzy Logic Ranking Indicator, have the potential and capability to classify the document according to the similarity of the document and demoting the negative document (*Fabricated and Shia Malay Translated Hadith*) from the top of the ranking results. The researchers believe that *FBMIR* performed slightly well compared to the *Vector Space Model* and BM25 original model based on the above finding due to *FBMIR*'s capability to demote negative documents and move up the relevant documents in the ranking list. This kind of scenario will help the student of Islamic Education or the public user to get the best retrieval results on their search query by its capability to demote the fabricated and the unreliable documents to the bottom of the search results. In the future, the researchers would like to try to add more negative documents into the experiment as well as several new features to enhance the evaluation. The researchers would also want to apply the use of a Malay Thesaurus, Hadith Ontologies Concept and positive corpus as a positive ranking indicator to observe the outcome of the experiment.

V. CONCLUSION

The researchers presented the implementation of the ranking function which combines the Fuzzy Logic with the *BM25* model of IR system that specifically used the data set of *Malay Text Corpus* of Malay Translated hadith that consist of 2026 *Malay Translated of Sahih Bukhari Hadith* text document and 160 *Malay Translated Fabricated Hadith* text document and use Fabricated and Shia Rate of Hadith as Negative Fuzzy Logic Ranking Indicator. Based on the experiments result and evaluation, *FBMIR* has slightly

outperformed BM25 original score and *Vector Space Model (VM)* on 11 queries, when the BM25 original score and Vector Space Model only yield a better result in 5 and 8 queries respectively on the P@10, %no measures and *MAP*. P@10 represents the values of *Precision at Rank 10* P@10), %no measures represent the percentage of queries with no relevant documents in the top ten retrieved and *MAP* represents Mean Average Precision of the queries. For the future works, the researcher would like to apply the usage of Malay Semantic elements and another corpus for a positive ranking indicator.

VI. ACKNOWLEDGEMENT

VII. REFERENCES

Alrazo, HM 2004, 'Computerized Frame of The Prophetic Tradition', in 17*th National Conferences for Computer, 2004*, Madenh: Scientific Publishing Center, pp. 597-611.

Ark Andreev, Galina Ivanova & Marwa Shouman, 'Comparison of Fuzzy Interference Systems for Documents Ranking Score', *The Eurasian Union of Scientist,* vol. 01, no.10, January 2015.

Ayub, 2018, 'Matn Criticism and Its Role In The Evaluation Of Hadith Authenticity'*, IJISH (International Journal of Islamic Studies and Humanities),* vol. 1, no.1, DOI: 10.26555/ijish. v1i1.136.

Azmi AM, AlOfaidly AM (2014) A novel method to automatically pass hukm on hadith.The 5th International Conference on Arabic Language Processing (CITALA '14), Oujda, Morocco.

Comfort T Akinribido, Babajide S. Afolabi, Bernard I Akhigbe & Ifiok J Udo, 2011, 'A fuzzy ontology based information retrieval system for relevant feedback', *International Journal of Computer Science*, *World Academy of Science, Engineering and Technology*, vol.8 no.1, pp.382-389.

Ghazizadeh M, Zahedi, MH, Kahani M & Bidgoli, BM 2008, 'Fuzzy Expert system in determining Hadith validity', *Advances in Computer and Information Sciences and Engineering,* pp. 354-359.

Ibnu Qayyim al-Jauziyah, 'Kenali Hadis Sahih, Dhoif, Palsu Al-Manar Al-Munif fi Al-Sahih wa Al-Da'if (751H) (Terjemahan al-Manār al-Munīf fi al-Ṣahīh wa al-Ḍa'īf); ed. Solehah Abu Bakar. Kemilau Publika, Selangor, Malaysia.

Jagendra Singh & Aditi Sharan, 2016, 'A new fuzzy logic-based query expansion model for efficient information retrieval using relevance feedback approach, *Neural Computing and Applications*, vol.28, no.9, February 2016, DOI: 10.1007/s00521-016-2207-x.

JAKIM, 1997, *Membendung Pengaruh Syiah Di Malaysia*, viewed 31st October 2018 http://e-smaf.islam.gov.my/e-smaf/index.php/main/mainv1/fatwa/pr/11851

Kawther A Aldhaln, Akram M Zeki & Ahmed M Zeki, 2010, 'Data mining and Islamic knowledge extraction: alhadith as a knowledge resource', in *Proceeding ICT4M 2010 Proceedings of the Information and Communication Technology for the Muslim World, 2010 International Conference.*

Lubna Nassar Abd Al Aziz, 2011, 'Enhancement of information retrieval ranking using fuzzy logic', Dissertations for Informatics (Knowledge and Data Management), Jun-2011 British University, Dubai, UAE.

Masoud Mohammadian, 2017, 'Modelling control and prediction using hierarchical fuzzy logic systems: Design and development', *Indicator International Journal of Fuzzy System Applications*, vol.6, no.3, July-September 2017.

Meisalo, V, Sutinen, E, & Tarhio J 2004, 'The possibilities of information retrieval in education', in *Current research on mathematics and science education, Proc. The XXI annual symposium of The Finnish Association of Mathematics and Science Education Research (eds. A. Laine et al.)*, University of Helsinki, Department of Applied Sciences of Education, Research Report 253, 2004, 528–549.

Moath M Najeeb, 2015, 'Multi-Agent System for Hadith Processing', *International Journal of Software Engineering and Its Applications*, vol. 9, no.9, pp.153-166.

Mohammed Q Shatnawi, Qusai Q Abuein and Omar Darwish, 2012, 'Verification hadith correctness in Islamic web pages using information retrieval techniques', *International Journal of Computer Applications*, vol. 44, no.13.

Olufade, F. W. Onifade, Member IAENG, Odile Thiéry, Adenike, O. Osofisan, & Gérald Duffing, 2010, 'Dynamic fuzzy string-matching model for information retrieval based on incongruous user queries' in *WCE 2010 Proceedings of the World Congress on Engineering 2010*, vol. 1, London, U.K, June 2010.

Rahman, NA, Bakar ZA & Sembok, TMT 2010, 'Query expansion using thesaurus in improving Malay hadith retrieval system', in *Proceeding, ITSim'10 Proceedings of The International Symposium on Information Technology – System Development and Application and Knowledge Society,* pp.1404-1409, 2010.

Rebhi S Baraka and Yehya M Dalloul, 2014', 'Building hadith ontology to support the authenticity of Isnad', *International Journal on Islamic Applications in Computer Science and Technology*, vol.2, no.1, pp. 25-39, December 2014.

Ricardo Baeza-Yates, Berthier Ribeiro-Neto 2011, *Modern Information Retrieval the concepts and technology behind search,* 2 edn, Pearson Education Limited, England, pp. 57-128.

Rodzman, SB, Ismail, NK, Rahman, NA & Nor ZM 2017, 'The implementation of fuzzy logic controller for defining the ranking function on Malay text corpus', in *Proceedings of 2017 ÌEEE Conference on Big Data Analytics (ICBDA 2017)*, 2017 Kuching, Sarawak, Malaysia.

Rouben, NO 2006, 'The application of fuzzy logic to the construction of the ranking function of information retrieval', *Computer Modelling and New Technologies*, vol.10, no.1, Cornell University Library, pp. 20-27.

Salha M Alzahrani & Naomie Salim (2009), 'On the use of fuzzy information retrieval for gauging similarity of Arabic documents', in *Proceedings of Applications of Digital Information and Web Technologies, (ICADIWT'09)*, 2009, London, pp. 539-544.

Salim, Naomie, 2008, 'Methodology of ontology extraction for Islamic knowledge text', in *Seminar Kebangsaan Pendidikan Sains dan Matematik, UTM* 2008.

Yogesh Gupta, Ashish Saini & Saxena, AK 2016, 'A comparative analysis of fuzzy based ranking functions for information retrieval', in *Proceedings of 3rd International Conference of Computing for Sustainable Global Development, (INDIACom)*.

Yuchen Zhou, Zuoda Liu, Beixing Deng, Xing Li, 2009, 'Improved fuzzy set information retrieval approach on duplicate webpage detection', *Journal of Information & Computational Science,* vol.6, no.2, pp. 1033-1041.

Yunus Yusoff, Roslan Ismail & Zainuddin Hassan, 2010, 'Adopting Hadith Verification Techniques into Digital Evidence Authentication', *Journal of Computer Science*, Science Publications, vol. 6, no.6, June 2010.

Zeng Y, Liu X, Wang Y, Shen F, Liu S, Rastegar Mojarad M, Wang L & Liu H 2017, 'Recommending Education Materials for Diabetic Questions Using Information Retrieval Approaches', *J Med Internet Res 2017*, vol.19, no.10, e342.