

## Muhadith: A Cloud based Distributed Expert System for Classification of Ahadith

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**Abstract** – *This paper presents a novel approach for the classification of the religious scriptures, the Hadith (sayings of Prophet Muhammad (plural Ahadith)). Muhadith is a distributed, Cloud based expert system that uses the Hadith science to classify Ahadith among 24 types from seven broad categories. Classification of the Hadith is a complex and sensitive task, and can only be performed by an expert of the Hadith sciences. Muhadith expert system is designed to imitate the Hadith experts for Hadith classification, and to enable a computer to behave like a Hadith expert to discriminate the authentic Ahadith from unauthentic ones. This paper presents the relationship and mapping of the expert system technology onto Hadith sciences, and technicalities involved in designing of the Muhadith expert system. We also propose solutions for the communicational and interoperability problems faced by the legacy web based distributed expert systems. We employ service oriented architecture to overcome the communicational problem and a candidature for the Software as a Service (SaaS) for the Cloud computing. The expert system also provides a reasoning facility that enables the user to look into the classification details. Muhadith expert system has been designed by merging the ideas from the domains of expert systems, Web technologies, and distributed computing systems. This type of an effort on the topic is rare and applying them in the domain of Hadith is our humble contribution.*

*Keywords: Expert system, Cloud computing, Islam, Hadith*

### I. INTRODUCTION

Expert system is an intelligent system that utilizes the inference procedures and knowledge of the domain to solve problems that require significant expertise of a human expert for their solution [1, 2]. Expert systems are employed widely to solve the complex problem in multiple domains, such as medicine, disease identification, agriculture, power supply, and oil exploration [1]. Classification of Hadith is one of most required task for a Muslim, so that the authentic religious practices can be distinguished from the unauthentic ones. Classification of Hadith is a complex and sensitive task and can only be performed by an

expert of Hadith sciences, as it involves huge knowledgebase and rules for the Hadith classification.

With the advent of World Wide Web (WWW), many Web based expert system have been developed [5-10]. Web based expert system provide ease and pervasiveness of use. Distributed Expert Systems (DES) [11-15] are used to divide a complex problem in multiple sub-problems to solve the problems in parallel efficiently. Communication system is one of the foremost design concerns in DES [16, 17]. Conventional DES uses complex communication methods [12]. Muhadith is designed using Service Oriented Architecture (SOA). SOA is employed mainly to: **(a)** overcome the communicational problems faced by the legacy web based distributed expert systems [33, 35] and **(b)** enable the Muhadith for Cloud computing and Software as a Service (SaaS) [4]. It has been reported that SOA delivers the basic infrastructure for the successful cloud implementation [5].

Muhadith is a Cloud based, distributed expert system. Major modules of the Muhadith are: **(a)** inference engine, **(b)** knowledgebase, **(c)** parser and fact extractor, **(d)** distributor and combiner, **(e)** sub-inference modules, **(f)** explanation facility, and **(g)** database. Muhadith design and module details and explained in Section 3. Figure 1 presents the design of the Muhadith expert system. Muhadith is designed to extract facts from the provided data, apply Hadith rules on the extracted facts, and classify the Hadith among 24 types in seven classes. Muhadith also provides necessary reasoning for the classification.

Major objectives in design of Muhadith are:

- Solve the identified communication problems of existing DES.
- Design rules for each class of Hadith, so that the application can act as a Hadith expert.
- Classification of Ahadith.
- Provide reasoning facility in expert system to find the cause for classification.
- Provide distributed infrastructure to process results efficiently.
- Provide multilingual architecture so that application can be localized.

The rest of the paper is organized as follows. A discussion related to the domain knowledge is presented in Section 2. Design and the modules of the Muhadith are discussed in Section 3. Implementation details are discussed in Section 4, and the discussion is concluded in Section 4.

## II. DOMAIN BACKGROUND

Hadith is defined as “a tradition or the collection of the traditions of Muhammad, the Prophet of Islam, including his sayings and deeds, and his tacit approval of what was said or done in his presence” [18]. Islam has two fundamental sources, Quran and Sunnah. It is agreed on that Quran is preserved in its real form, as narrated in Quran “We have undoubtedly sent down the Reminder, and We will truly preserve it” [19]. Sunnah of Prophet (PBUH) is also included in above promise by necessity, as a practical example of Quran implementation [20]. Quran cannot be understood correctly without Sunnah [20]. Companions of Prophet Muhammad and those coming after them has preserved Sunnah by memorizing, writing down, and then passing it, generation by generation to others [20]. Need for verification of chain of reporters arise, when people other than the companions started to narrate directly from the Prophet. A crucial reason for the verification was because of the different false sects that started the deliberate fabrication of Ahadith. So different scholars of Hadith (Muhaditheen) worked to collect Hadith knowledge and created strict rules for approval of Hadith. On the basis of these rules every Hadith can be checked and authentic Ahadith can be differentiated from the fabricated ones. Because of the complexity and massiveness of the related knowledge, only an expert of Hadith sciences can classify a Hadith. A normal person is unable to find whether the Hadith is authentic or unauthentic.

A Hadith is composed of two parts, **(a)** text of the Hadith and **(b)** chain of the reporters. Authenticity of Hadith is checked by applying different rules on text of the Hadith and chain of reporters, known as *Mustalah-al-Hadith*. Ahadith can be classified into seven major classes according to the: **(a)** Reference to a particular authority (ATR), **(b)** Links in the chain (ATL), **(c)** Number of Reporters (ATN), **(d)** Nature of text (ATNt), **(e)** Manner in which Hadith is reported (ATM), **(f)** to Hidden defect found in Isnad or text of Hadith (ATH), **(g)** Reliability and memory of reporters (ATR). Detailed discussion of these classes can be found in [2].

Muhadith uses the rules defined for these classes, and classifies the input Hadith in a sub-type of these classes along with the reason and explanation for classification. Muhadith can help experts of Hadith in taking decisions and also to a non-expert to understand that why a Hadith is said authentic and other as unauthentic.

## III. DESIGN OF MUHADITH

Major modules of Muhadith are: **(a)** inference engine, **(b)** knowledgebase, **(c)** parser and fact extractor, **(d)** distributor and aggregator, **(e)** sub inference modules, **(f)** explanation facility, and **(g)** database. Muhadith provides a Web interface for the users to query the expert system. User’s query is passed to the Web server. At Web server, query is parsed and required data is extracted from user’s input. Extracted data is then sent to the fact extractor, which in turn connects the database to fetch the related information.

The fact extractor extracts the facts from the information and these facts are then passed to distributor component, which in turn connects to six Web services to execute six sub-inference components in parallel. These six sub-inference components are developed for different classes of the Hadith. Each of these six sub-inference components deals with a specific class of Hadith. Each of these components has local inference capability and local knowledgebase. Each component connects to data provider to fetch specific facts from database. Each component is also attached with explanation module. This explanation module is used to explain the reason for the classification of Hadith to user. Every sub-inference components returns results to the combiner module that amalgamates and returns the results of all classes of Hadith to the user. Details for each module are as follows.

### A. Muhadith Inference Engine

Muhadith inference engine possess dual interactivity. It interacts with the : **(a)** user query to extract the facts from the provided data, and **(b)** knowledgebase to fetch rules that can be applied on the extracted facts from the user. Inference engine is divided in following sub-modules.

#### i) Parser and Facts Extractor

Data provided by the user is passed to the parser module for parsing. User inputs the text of Hadith and may provide chain of the reporters. The chain of reporters is a string containing names of all the reporters and commonly used words in the chain. Parser extracts names of the reporters from the chain and passes the parsed information to the fact extraction module. The facts extraction module requires the information on the reporters to build and extract the facts for decision. Therefore, the facts extractor, prior to extracting facts, interacts with the facts provider module. The facts provider module is intended to provide the detailed information against the reporter’s name. To find the reporters information, the fact provider interacts with the database and fetches the information on the reporters.

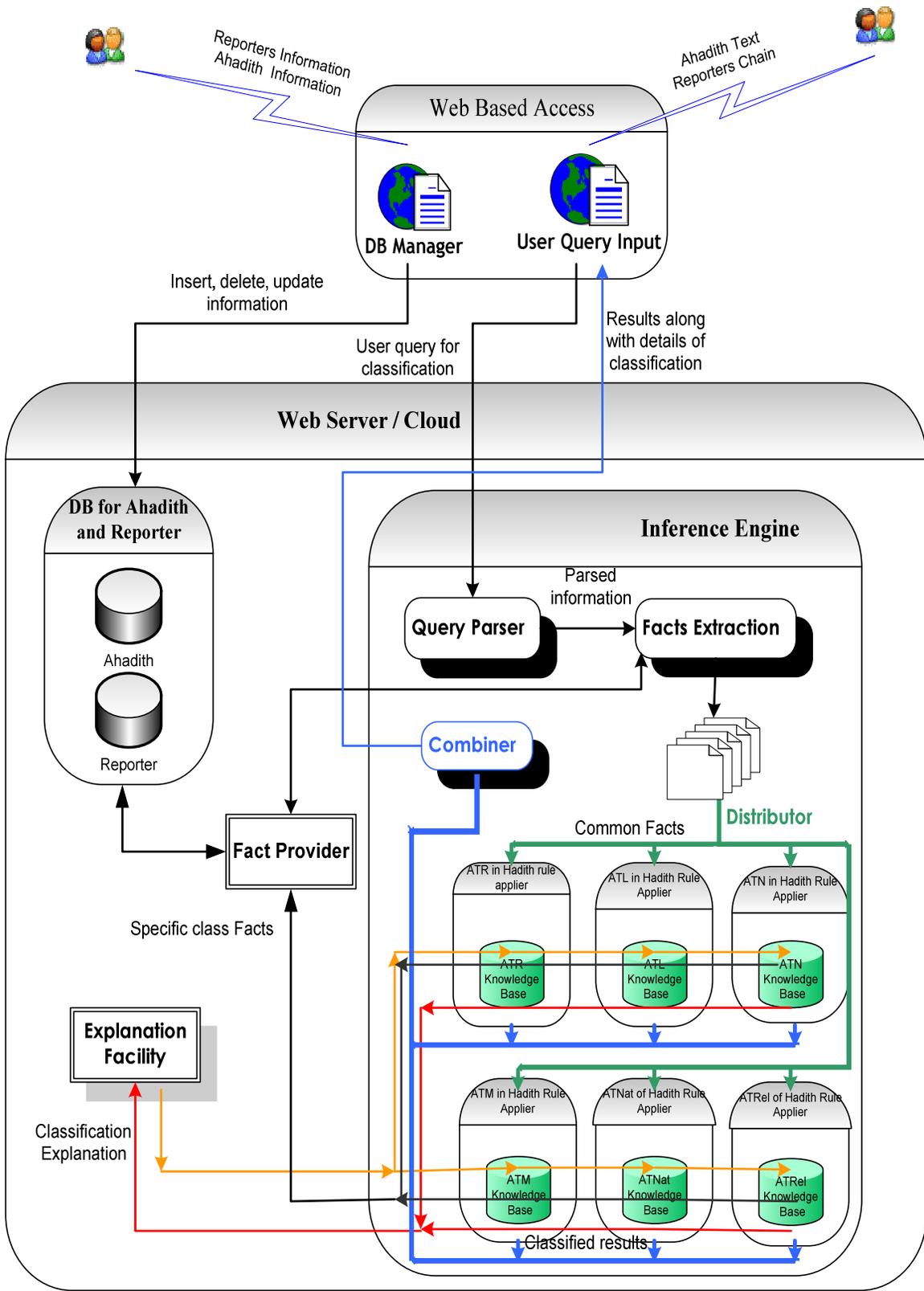


Figure 1: Design of Muhadith Expert System

This information is sent back to the fact extractor, which in turns extract required facts from the received information.

ii) *Distributor and Combiner*

The distributor module acts as a scheduler and distributes the facts to different sub-inference modules for processing and classification. The combiner module collects results and explanations from the sub-inference modules, arranges them in a presentable format, and passes all the information back to user.

iii) *Sub-inference Modules*

Scholars have categorized the Hadith in seven major classes based on various attributes [20]. In the Muhadith expert system, we have developed separate sub-inference modules for each of these classes. Each sub-inference module has its own local knowledgebase that contains rules. Every sub-inference module targets a specific class among the seven Hadith classes and has different rules and information. A sub-inference

module receives the facts from the distributor. Each sub module can interact directly with the fact provider to find any module specific information from the database. Each sub-inference module also interacts with the explanation module for reasoning and explanation. After applying rules on available facts and interaction with explanation facility, each module returns the results to combiner.

B. *Muhadith Knowledgebase*

Muhadith is a rule-based expert system. Knowledge is represented in form of binary decision-tables, and rules are defined in form of IF THEN ELSE statements. A comparative study of IF THEN rules and a decision-table is provided in [21]. As we have multiple classes of Hadith, so each class of the Hadith has separate knowledgebase. Each component has its own decision-table and rules.

General format for knowledgebase rules of Muhadith is as follow.

```
<Rule Id>: <Rule Name>
[COMMENT :<"Comment text">]
IF <condition>+ THEN <conclusion> | IF <condition>+ THEN <conclusion> [ELSE]
<Conclusion>
END IF
```

An example of the first rule for this knowledgebase is

```
ATR1 : Marfu1
COMMENT: "This is rule to identify a Marfu Hadith under According to Reference (ATR) class of Hadith"
IF (Prophet = yes) AND (Companion = yes) AND (Successor=yes)
THEN
CONCLUSION: Marfu
END IF
```

An example of decision-table for class "According to Reference to a particular authority (ATR)" and rules derived from it is shown in Table 1.

Inference chaining diagram for the above class of Hadith is shown in figure 2.

Table 1: Sample Decision-table for Muhadith Knowledge representation

Hadith type ATR	Prophet	Companion	Successor	Marfu Words	Quranic Reference
Marfu	√	√	√	NA	NA
Marfu	×	√	√	√	NA
Marfu	×	√	√	NA	√
Mauquf	×	√	√	×	×
Maqtu	√	×	√	NA	×

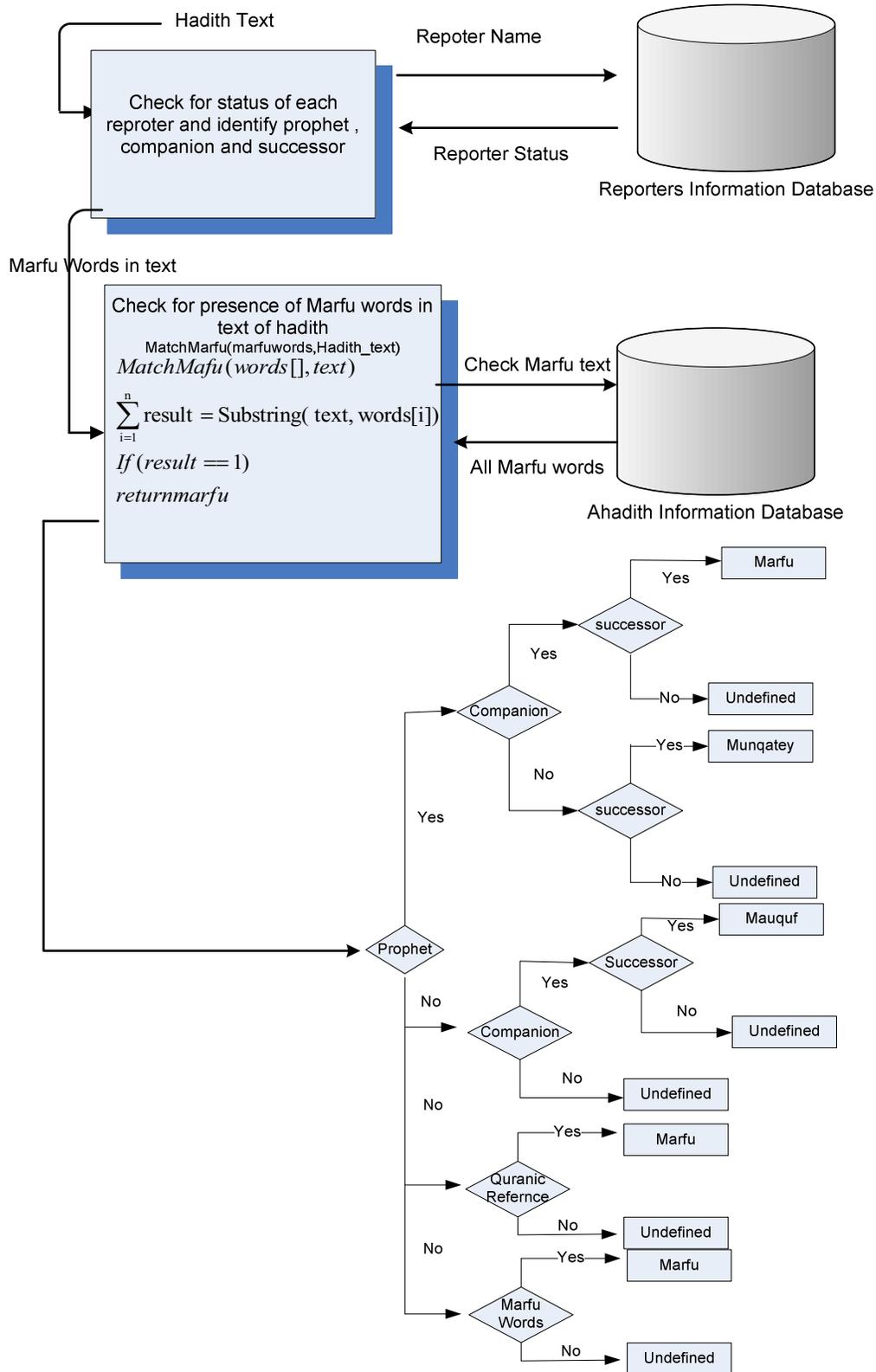


Figure 2: Inference Chaining Diagram for According to Reference Class

Each class has its own decision-table, rules and inference chaining diagram. Because of the space constraints, we have provided the decision-table, rules and inference chaining diagram only for a single class named “According to reference to a particular authority” in the paper.

### C. Muhadith Explanation Module

Explanation facility is used in expert systems to provide details to user regarding how and why a conclusion has been drawn [29]. Muhadith explanation facility is used to provide the details for classification of Hadith.

## IV. MUHADITH IMPLEMENTATION

Muhadith is implemented as a SOA based Cloud expert system accessible through Web. Microsoft .NET is used as development platform. Programming languages used for Muhadith are C#.Net and Asp.Net. SQL server is used as database management system. Users can enter the Hadith using the Web interface. Input information is passed to the inference engine and results along with the explanation are returned back to the users.

## V. CONCLUSIONS

A novel approach has been used to simplify and digitize the task of Hadith classification. Service Oriented Architecture (SOA) is used for Cloud computing compatibility, and to solve the communication problems faced by the legacy Web based distributed expert systems. Muhadith enables a layman having little knowledge of Hadith sciences to distinguish authentic Ahadith from unauthentic ones. Ahadith can be successfully classified along with explanation. Fabricated Ahadith can be easily distinguished from authentic ones. Some aspects of Hadith classification that depends on common sense are not covered by the Muhadith. Muhadith is heavily dependent on data of Ahadith and reporters. Our aim was not to build the Hadith and reporters database, rather our humble contribution was to provide a platform and infrastructure for the expert system. Moreover, we are also working to implement the Muhadith as SaaS for Cloud computing.

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