



An Incremental Knowledge Base dedicated to Muslim Worship

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ABSTRACT

The conceptual graph is a universal formalism for knowledge representation where the nodes of the graph are the concepts linked by a relation of partial order. A conceptual graph can be viewed as an intermediate language permitting to translate computer-oriented formalisms to and from natural languages. The aim of this work is to develop an incremental knowledge base dedicated to Muslim worship, incorporating consistent and non-redundant information. The knowledge acquisition and the representation processing make use of the conceptual graph formalism enhanced with stamping. Further, the proposed knowledge base is extrapolated to a web application in the hope to using it for educational and teaching purposes for anyone interested in the field of Muslim worship.

Keywords: knowledge representation, conceptual graphs, stamping, knowledge base, Muslim worship, Islam concepts.

1. Introduction

Islam is a religion that means wholeness, safeness and peace. It is the monotheistic and the revealed religion from Allah articulated by the divine book “the Holy Quran”, the perfect and complete book available to mankind for guidance. Islam is in fact not only a religion but a complete code of life. It governs a Muslim's life in all its aspects. When we read the Holy Quran or the Hadith of the Prophet Mohamed (pray and peace be upon him), we can find all the necessary instructions and guidelines regarding all aspects of the human life such as: religious, economic, social, material, political, cultural values, etc.

In this paper, we try to develop an incremental knowledge base dedicated to Muslim worship, incorporating consistent and non-redundant information. The knowledge acquisition and the representation processes make use of the conceptual graph formalism enhanced with stamping. The conceptual graph is a universal formalism for knowledge representation proposed by John Sowa (Sowa, 1976; Sowa, 1984). A conceptual graph is a connected graph formed by a set of concepts and relations. The concept nodes represent entities (objects), attributes or actions (events). The relation nodes are the relationship (link) between two concept nodes. The conceptual graph formalisms have been used for knowledge representation in several domains (Tang, 2012; Sowa, 1999; Way, 1992; Chein & Mugnier, 2014). Among them, we cite: the information retrieval (Ordoñez-Salinas & Gelbukh, 2010; Miranda-Jiménez *et al.*, 2013), the neural network for pattern recognition (Lendaris, 1990),

the expert systems (Kokkoras & Vlahavas, 1995), the natural language processing (Sowa, 1991), the database (Sowa, 1976), and the ontology design (Buche *et al.*, 2008). Authors in (Khan *et al.*, 2013) proposed an ontological work for semantic search in Holy Quran. In (Saad *et al.*, 2008), authors worked on extraction key phrase for developing ontology of Islamic literature.

The goal of the current work is to develop a system that generates and manages the knowledge and controls its integrity and its consistency. Such system will facilitate the tasks of the expert who create and manipulate the descriptions and the different concepts which are in general in textual forms. It permits to develop a knowledge base that incorporates consistent and non-redundant information.

We note that, the structure of the proposed knowledge base is based mainly on the notions of conceptual graph, stamping and relationship tables. The knowledge base can be extrapolated to a web application in the hope to using it for educational and teaching purposes.

The paper is organized as follows: Section 2 presents in detail the modeling and the design of the proposed knowledge base (KB). Section 3 shows how the KB can be exploited by using a web application. Finally, we conclude and address some future works.

2. The design of the proposed knowledge base

In this section, we present the design of the proposed knowledge base dedicated to Muslim worship. We use the conceptual graph formalism enhanced with stamping in order to represent and manipulate concepts related to Muslim worship. The adopted formalism allows for better readability and a good view of concepts description. It permits a clear representation of knowledge and concepts. Among the concepts worship in Islam manipulated in the proposed knowledge base, we mention the following.

- The concept of “faith” or belief called “El-Iman” in Arabic that includes: belief in One God, Allah, belief in all of God's messengers, belief in the Prophet Muhammad (pray and peace be upon him), belief in all the books sent down to the prophets. The Holy Quran is the only divine book in extant today in the original revealed form, belief in the existence of angels, belief in the Day of Judgment and belief in the divine decree or predestination.
- The concepts regarding the Prayer (Salat), the alms (Zakat), the fasting (Siyam) and the pilgrimage (Hadj).
- The concept of relationships actions such as the concept of legal justice, the marriage, and the trade.
- The concept of spiritual education: the concept of morality, the good manners and the public rights.
- The concepts regarding the call to God: the foundations of appeal to God, and the merits of calling upon God.

All these concepts and the links between them are represented by using the conceptual graph formalism. We note that the development of the proposed knowledge base is through interaction with the expert. The structure of the knowledge base is based mainly on three notions which are: the conceptual graph, the composition hierarchy (stamping table) and the

relationships table. The composition hierarchy plays an important role in the knowledge acquisition. It is based on the primitive conceptual graph which is the starting point of the incremental explanation process. The stamping table, in turn, allows us to infer whether a concept is a generalization or a specialization of another concept (ascending or descending, direct or indirect). The relationships table, which goes along with the stamping table, at any inference, permits to express and infer links between concepts. In addition, we use the dual notions "*relation - inverse relation*" and "*question - inverse question*" in the concern to ensure a direct access to the information.

Starting from a set of known concepts with complex descriptions, the objective is to build a knowledge base that will be used implicitly or explicitly by the expert. However, building knowledge base involves the following tasks:

- The initialization: that permits to initialize the kernel of the proposed base. This core point is represented by a graph that we called "*the primitive conceptual graph*".
- The classification: this step is used to set a new concept (new description) provided by the expert in the hierarchy of composition, stamping table and the relationships table.
- The descriptions of a concept: that permits to edit a concept. For each concept, we associated a hypermedia text description (html) and descriptions images, videos and ect.

It should be noted that discrimination between concepts of the same class (so-called brothers' concepts) is deliberately left to the expert opinion that in this work we are not dealing with a taxonomic approach. The different steps of the proposed approach will be detailed in the following subsections.

2.1. The knowledge acquisition

The knowledge acquisition process involves both the explanation and the modeling of the concepts. It consists of extracting knowledge and organizing them. In our case, the acquisition process is incremental where a generic description of the concepts is defined initially by the expert of the domain in the form of a conceptual graph. The latter is the root of the hierarchy of the generalization of the manipulated concepts. The knowledge acquisition is based on the use of specialized operations defined on the conceptual graph formalism (Sowa, 1984).

2.2. The structure of the knowledge base

In the sociological sciences such as the science of religion, the description of concepts which is well expressed in natural language, however, is quite structured. We distinguished between basic knowledge, concepts and relations between them. The compound concepts called *composite concepts* are composed of other concepts. In our case study, the basic concepts and descriptive concepts are composite concepts (except the leaf concepts). On the other hand, we defined the two relations which are:

- The relationship "Based on": it is a relationship of composition that generates the key concepts (basic) of the domain.

- The relationship “Characterized” is a descriptive relationship that generates the descriptive concepts.

Example 1 shows the structure of the concepts in the base and relations between them. The concepts nodes are denoted with brackets. The relation nodes are the relationship between two concept nodes. The relations are denoted with parentheses.

Example 1:

- **The basic knowledge:** [Faith] \rightarrow (Based on) \rightarrow [The causes that make faith obsolete]

Basic concept: Faith, The causes that make faith obsolete,

Inclusive relationship: *Based on*

- **The Descriptive knowledge:** [The causes that make faith obsolete] \rightarrow (Characterized) \rightarrow [Hypocrisy]

Descriptive concept: Hypocrisy,

Descriptive relationship: *Characterized*

To build the knowledge base, we started from an initial graph which is the initial structural model of the domain and uses descriptive framework of knowledge of the expert. This graph is composed mainly of:

- The root concept: Muslim worship
- The set of basic concepts.
- The characteristics or the basic description of concepts

The conceptual graph base includes initially the original graph scope and will be progressively refined by newly acquired concepts.

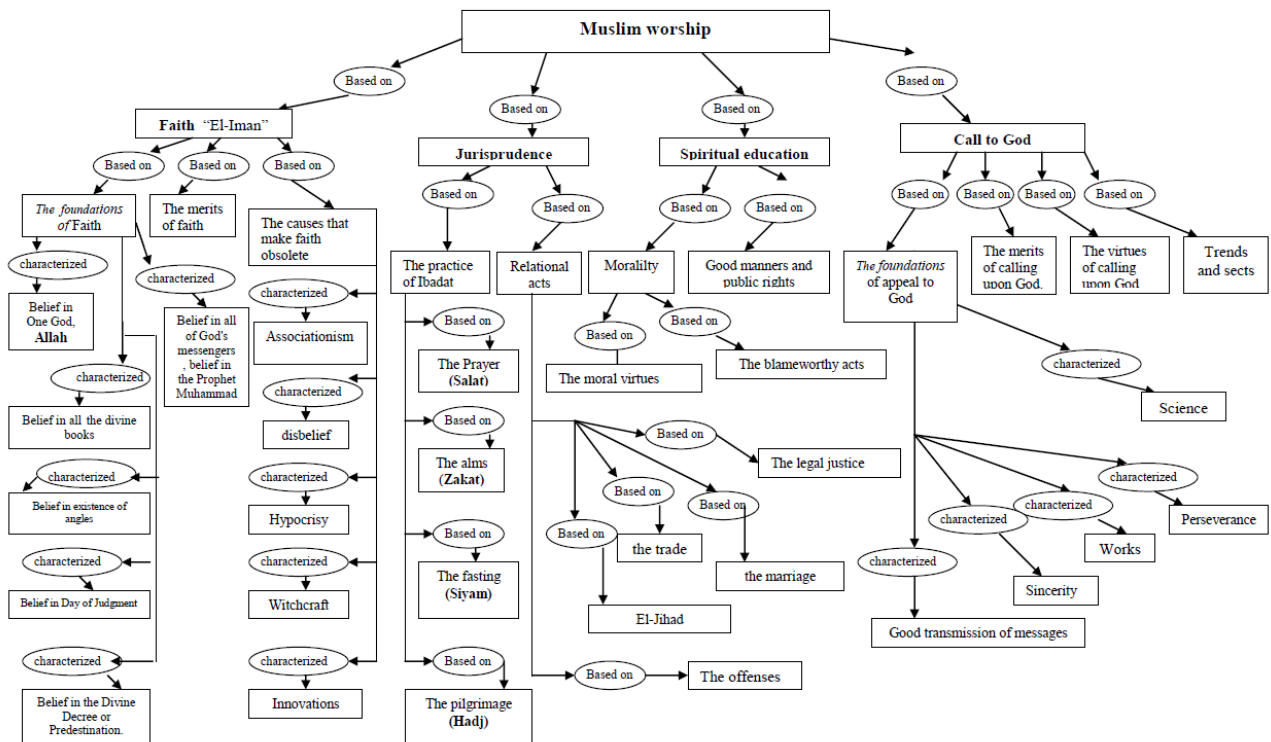


Fig 1. An example of conceptual graph for the Muslim worship.

Fig 1 gives an example of conceptual graph for the Muslim worship. For example, the Muslim worship concept (the root concept) is composed of four basic concepts which are: Faith “El-Iman”, Jurisprudence, Spiritual education, Call to God. The concept (Faith “El-Iman”) is composed of three concepts which are: the foundations of Faith, the merits of faith and the causes that make faith obsolete.

The main characteristics of the foundations of Faith are summarized in the six points which are: Belief in One God, Allah, Belief in all of God's messengers, Belief in the Prophet Muhammad (Pray and peace be upon him), Belief in all the divine books, Belief in existence of angels, Belief in Day of Judgment, Belief in the Divine Decree or Predestination.

The conceptual graph given in Fig 1 could be extended and enhanced by adding more detailed concepts and characteristics.

2.3. The stamping table

The stamping for a concept permits us to show clearly the "path" that should be followed in the lattice composition for adding a new concept or searching in the knowledge base. In the following, we show how to compute the stamping of a concept.

First, we insert the root composite concept (Muslim Worship) in the stamping table and we assign to it the stamp $X=0$. Then, we add all composite concepts newly inserted in the stamping table. We used a counter n initialized to 1 the first concept (Child) will be numbered 1 and the second will be 2 and so on. The list of Child concepts is set initially to empty (). For each composite concept newly inserted in the list of Child concepts of a Parent concept whose stamp concept is X , we associated the stamp Xn where n is the insertion sequence number in this list. In turn, this Child concept is inserted after composite concepts that are prior to it. If a composite Child concept is empty, it represents then a “leaf” in the hierarchy of the current composition. Table 1 gives an example of stamping table. The stampings table permits to easy navigate in the structure: the lattice composition, to reduce the access time to a given composite concept, to reduce the number of questions; the dialogue is shorter and not boring by the expert and to allow inferences to answer any questions asked by a user. An example of the stamping of lattice composition is depicted on Fig 2.

Table 1: Example of stamping corresponding to Hierarchic composition

Composite Concepts	Stamping	List of concepts child
Islam Worship	0	(Faith, 1), (jurisprudence,2), (Spiritual education, 3) (Call to God, 4)
Faith El-Iman”	0.1	(<i>Foundations of Faith</i> , 1), (<i>The merits of faith</i> , 2), (<i>The causes that make faith obsolete</i> , 3)
Jurisprudence	0.2	(The practice of Ibadat, 1), (Relational acts, 2)
Spiritual education	0.3	(morality,1), (Good manners and public rights, 2)
Call to God	0.4	(<i>The foundations of appeal to God</i> , 1), (The merits of calling upon God, 2), (The virtues of calling upon God, 3) (Trends and sects, 4)
The Foundations of Faith	1.1	()
The merits of faith	1.2	()
The causes that make faith obsolete	1.3	()
The practice of Ibadat	2.1	(The Prayer ,1), (The alms, 2), (the fasting, 3) Pèlerinage,4)

Relational acts	2.2	(The trade, 1), (the marriage, 2), (crimes, 3), (El-Jihad, 4)
Morality	3.1	(The moral virtues, 1) (The blameworthy acts, 2)
Good manners and public rights	3.2	()
The Prayer (Salat)	2.1.1	()
The Alms (Zakat)	2.1.2	()
The Fasting (Siyam)	2.1.3	()
The Pilgrimage (Hadj)	2.1.4	()
The trade	2.2.1	()
The Marriage	2.2.2	()
The offenses	2.2.3	()
El-Jihad	2.2.4	()
The moral virtues	3.1.1	()
The blameworthy acts	3.1.2	()

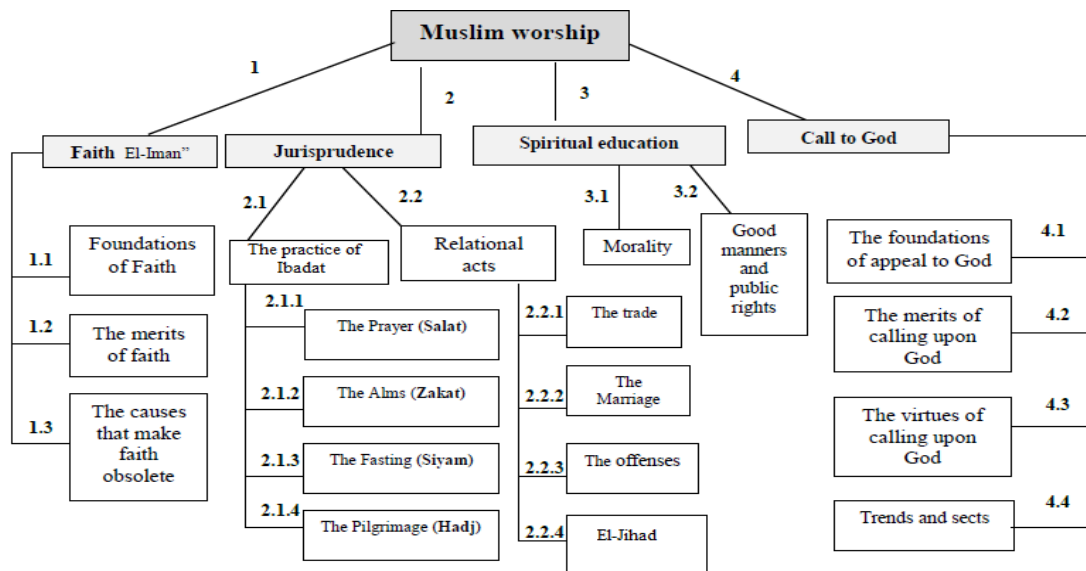


Fig 2. Example of the stamping of lattice composition

2.4. The relationship table

The stamping table allows us to infer if a concept is a generalization or a specialization of a concept, and even the ability to infer whether a set of concepts is a generalization or a specialization of a given concept. However, based solely on the stamping we lose relationships that link the concepts, resulting in a loss of expressiveness which penalizes the semantic and linguistic richness of the application domain. For this, we further use a "table of relationships" which is a structure that goes along with the stamping table at all inferences. The relationship table summarizes all relationships between the couple of concepts (*Parent*, *Child*) as shown in Table 2. The relationships table is improved by using the notion of inverse question and inverse relation.

- The "inverse relation" allows inferences from the *Child* concept to his ancestors. We recall that the use of the relationship between *Parent* and *Child* down allows inferences from the *Parent* to his descendants.

- The notion of "question" and "inverse question" help the user in formulating queries. The direct "question" covers the direct "relation" and the "inverse question" concerns the so-called "inverse relation".

As shown in Table 2, we use two inverse relations. The first "engender" which is the inverse expression of the direct relation "Based on". The second "specify" which is the inverse expression of the direct relation "Characterized".

Table 2: The table of relationships

Relation	Question	Inverse Relation	inverse Question	List of couple of concepts (<i>Parent, Child</i>)
Based on	Whereupon?	engender	Which concept?	(Islam Worship, Faith El-Iman"); (Islam Worship, Jurisprudence); (Islam Worship, Spiritual education); (Islam Worship, Call to God); (Faith El-Iman", The Foundations of Faith); (Faith El-Iman", The merits of faith); (Faith El-Iman", The causes that make faith obsolete); (Jurisprudence , The practice of Ibadat); (Jurisprudence, Relational acts) ; (Spiritual education, Morality); (Spiritual education, Good manners and public rights); (Call to God, The foundations of appeal to God); (Call to God, The merits of calling upon God); (Call to God, The virtues of calling upon God); (Call to God, Trends and sects) ; (The practice of Ibadat, The Prayer (Salat)); (The practice of Ibadat, The Alms (Zakat)); (The practice of Ibadat, The Fasting (Siyam)); (The practice of Ibadat, The Pilgrimage (Hadj)); (Relational acts, The trade); (Relational acts, The Marriage); (Relational acts, The offenses); (Relational acts, El-Jihad); (Morality, The moral virtues); (Morality , The blameworthy acts)
Characterized	Whereby?	Specify	What..?	(The Foundations of Faith, Belief in One God, Allah); (The Foundations of Faith, Belief in all of God's messengers, belief in the Prophet Muhammad Pray and peace be upon him); (The Foundations of Faith, Belief in all the divine books); ; (The Foundations of Faith, Belief in existence of angles); ; (The Foundations of Faith, Belief in Day of Judgment); (The Foundations of Faith, Belief in the Divine Decree or Predestination); (The causes that make faith obsolete, Associationism); (The causes that make faith obsolete, disbelief); (The causes that make faith obsolete, Hypocrisy); (The causes that make faith obsolete, Witchcraft); (The causes that make faith obsolete, Innovations); (The foundations of appeal to God, Science) ; (The foundations of appeal to God, Perseverance); (The foundations of appeal to God, Works); (The foundations of appeal to God, Sincerity); (The foundations of appeal to God, Good transmission of messages)

Hereby, we give examples of a query with direct “relation”, two queries with “inverse relation” and a large range query.

- **Direct relation**

Query: [Faith] → (Based on) → [?]

Question: Whereupon Faith is based on?

Response: “The Foundations of Faith”, “The merits of faith” and “The causes that make faith obsolete”.

- **Inverse relation**

Query: [?] → (engender) → [Prayer]

Question: Which concept engenders the Prayer? Response: “The practice of Ibadat”.

Query: [?] → (specify) → [Hypocrisy]

Question: What specify the Hypocrisy? Response: “The causes that make faith obsolete”.

The stamping and relationship tables permit us to handle also queries with a large range such as:

Question: What is the relation between Prayer and Faith? **Response:** “Prayer is based on Faith”.

3. The extrapolation to a web application

The conceptual graph base may be represented as a vector where each of its components symbolizes the description of a concept (name, stamping, html page, image and ect.), the link and the type of relation with concepts (Parent, Child, next). The knowledge base consists of: the vector of concepts, the stamping and the relationships tables. We acquire simultaneously both knowledge base (concepts) and the nodes of the hypermedia system. In this way, the information nodes are incremental and created simultaneously at the same time that knowledge is elicited when a new concept is acquired. The overall system depicted in Fig 3. It consists of six components which are detailed as follows:

- **Web Interface:** is the module that ensures the interaction between the knowledge base and the different users. By using this interface, the Knowledge base may be updated only by the expert with protected access in expert /administrator mode. This interface module can be implemented as a site Web.

- **Knowledge acquisition** is a module with a secure password, available only for administrator / expert. The latter can introduce new concepts, update, modify, delete, and update links and any description of concepts or information.

- **Consistency/ integrity Controller** is the module that verifies the integrity and the consistency of the knowledge base and avoids redundancies. The system requires that a concept has only one Parent. This restriction avoids ambiguity in the KB.

- **KB:** is the knowledge base including the vector of concepts, the stampings and the relations tables.
- **Access Manager:** is the module that manages the navigation on the Web application, exploiting links to pages that contain descriptions of concepts (text, image and ect.).
- **Queries (information retrieval)** is the module that ensures a direct and rapid access to information by exploiting the inference aspect of the KB.

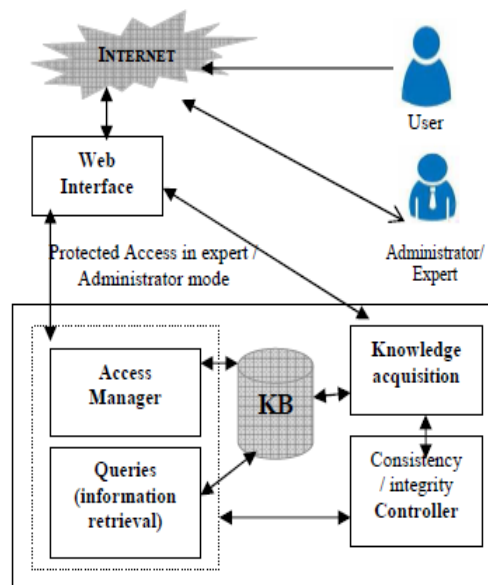


Fig 3. The overall system architecture

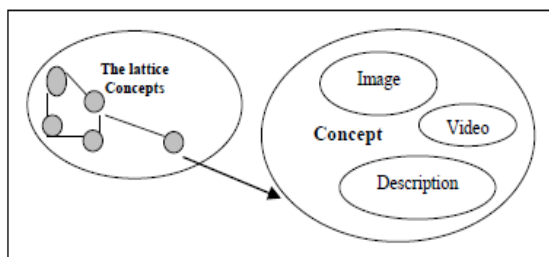


Fig 4 shows the matching between the information nodes and the objects of the conceptual graph formalism. This permits to well structure the hypermedia system, the information nodes and the links between these nodes

Fig 4. The navigation in the hypermedia knowledge base.

4. Conclusion

This paper focused on the knowledge base for Muslim worship formalized with the conceptual graph paradigm which is enhanced with stamping. The knowledge base could be extrapolated to a web application or a dynamic web site for exploitation and for educational and teaching purposes for anyone interested in the field of Muslim worship. As perspectives we plan to improve the current work by adding the possibility of multi-experts knowledge where several experts can manage simultaneously the knowledge base and update it which implies the problems of concurrent access that should be taken into account when adding such possibility.

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