

## Automatic Mind Maps Generation for The Holy Quran

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**Abstract.** Millions of Muslims around the world welcome initiatives that improve how people read, recite, comprehend, and, memorize the wonderful lessons contained in the Holy Qur'an. The majority of the Holy Quran learners suffer from lack of quality in memorization understanding and connecting its topics. Therefore, the aim of this paper is to develop an algorithm that automatically generate the topics based on the mind map of a set of verses in the Holy Quran. By using this approach, we found the topics of all sets of verses based on the Topical Mushaf and Al-Duwayish mind map of Surat Al-Baqarah. **Keywords:** Automatic generation, mind-mapping, Holy Quran, Quranic topics, information management.

### 1 Introduction

Mind mapping is a creative technique and logical means of note-taking that "maps out" your ideas. Tony Buzan, an English memory expert, developed the method of mind mapping. This method is the result of studies into how the brain processes and retains information is not logically, phase by phase, but at random. On the other hand, the brain stores information in the form of a picture rather than an article or letter (Ari, 2016). A mind map is generated by putting down a key concept and then brainstorming fresh and related ideas that radiate out from it. You can map knowledge in a way that will help you better absorb and retain information by focusing on essential ideas written down in your own words and looking for links between them (Anonim, 2014). In recent years, scholars and educators have begun to use software mapping tools for a wide range of educational goals. The tools are typically used to assist learners gain critical and analytical abilities, as well as to enable students to find connections between concepts and as a kind of assessment. All these tools have one thing in common that they all use diagrammatic relationships of various kinds instead of written or spoken descriptions (Melahi, 2021).

Although there are many methods used to ensure the preservation of Quran, memorizing technique that uses repetition method is still used to ensure that the Quran remains intact in the hearts of its learner. Strong memorization of the Quran is not an easy thing to be done by every Muslim. To produce a good and strong memorization and be able to remember all parts of the Quran, the Muslim individual must follow the specific rules to ensure his memorization is really stick well in his mind (Al-Mosallam, 2015).

The aim of this paper is to develop an algorithm that automatically generate the topics based on the mind map of a set of verses in the Holy Quran. This work is significance because it will enhance the understanding and memorization of the Holy Quran by viewing the concepts in a way that is easy for the brain to perceive. Moreover, it could help extract new knowledge from the Holy Quran from the generated mind maps and facilitate the understanding of Tafsir. This research found the topics of all sets of verses based on the Topical Mushaf and Al-Duwayish mind map of Surat Al-Baqarah.

## 2 Literature Review

Memorizing the Quran requires a strong memory and the practice of constant repetition, it is often seen as a challenging skill to master. Numerous studies have revealed difficulties with memorising the Quran due to complexity and misinterpretation of the meaning, poor memories, environmental distractions, and concerns with Quran comprehension (Mustafa et al., 2021). To preserve the integrity of the Qur'anic contents, the companions then continued on and practised the custom of memorization. A person who writes down the entire Qur'an is regarded to as a "Hāfīz," and the phrase "Tahfīz al-Qur'an" means the practice of memorizing the Qur'an (Altine, 2019). There are different methods to improve Qur'anic memorization including topical interpretation of the Quran which is one method for increasing memorization of the Qur'an that has been used by researchers in various ways and processes to deepen their understanding of Quran and as a result, improve and master their memorization. Also, A mind map is a visual representation of information. In the process of memorising the Quran, Topical Interpretation of the Quran could be integrated with modern visualisations, such as mind maps, to save time, effort, and money while also raising learner achievement levels (Al-Mosallam, 2015).

### 2.1 Related Works

Al-Mosallam (2013) discussed in her paper, how to improve the memorization of the Holy Quran using mind maps. The problem that the researcher found in her research was that most students in Quranic schools suffer from the lack of quality Quran memorization techniques. The researcher proposed a mind mapping to connect topic and concepts of Quran and provide visual aids for the students to understand and remember what they learned. The researcher had conducted a pilot study in a group of students and found that the student's memorization process has very much improved. The experiment has three measurement criteria, which are the understanding of the meaning, the memorization time and the number of mistakes. Mind maps method has shown that it can increase the understanding, reduce the memorization time, and reduce the number of mistakes. Applying visualization technique like mind maps with the topical interpretation of the Holy Quran provide many benefits for the learners. They can save time, effort, cost and increase the overall achievements which is an additional method with the traditional repetition method for the Holy Quran learning. It allows the learner to be attentive and more focused in summarizing and generalizing the information. Although Al-Mosallam (2013) proved that there is a positive impact of using mind maps in the teaching the Holy Quran and her study only use a ready-made manual mind map. however, this study will try to automate the process of mind map generation of the Holy Quran.

Mind maps technique will not replace the traditional repetition method. Al-Shanqeeti (2007) stated that repetition method is the conventional technique that is used to memorize the Holy Quran. It is still used to make sure that the memorized Quran remains intact in the learner's heart. The researcher has mentioned the advantages and disadvantages by comparing the technical work in the Quran memorization using the repetition method. Al-Duwayish (2017) wrote a book about applying mind maps on

chapter two of the Holy Quran (Surat Al-Baqarah) as a sample. The researcher emphasis in the understanding of the qur'anic words meaning and the general topic to enable the learner to make links between verses and understand the topic of the verses. Almosallam et al. (2015) work in the development of a mobile application that work on Android operating system. This app is developed to help the Holy Quran learner to master their skills of memorization of the Holy Quran. Mind maps have been used in online meeting as cited by Him and Yonezawa (2018) as mind maps were used to stimulate the ideas that emerge in the web meetings. The mind map is generated on the web environment using HTML5 with JavaScript language. Miyasugi, Akaike, Nakayama and Kakuda (2017) proposed a system to manipulate mind maps in a virtual reality space using hand gestures. The system can work for multiple users. It provides a limitless screen size because it uses VR technology and display the mind map in 3D view. Brinkschulte, Enders, Rebstadt and Mertens (2016) present a new tool for editing ontologies. Zarzour, Abid and Sellami (2014) used mind maps to make a collaborative decision making with no conflicts. Their research focused on overcoming the issue related to the consistency in collaborative decision-making system using mind mapping. The proposed solution allows it to be used in distributed locations to work together remotely to achieve the common goal in a peer-to-peer network.

### 3 Methodology and Data Collection

The methodology will contain three main phases, which are the data collection, implementation and the evaluation and testing as they are illustrated in (Figure 1). First, the data collection phase will focus in data gathering process from different data sources. It will also cover the drawing guidelines of the mind maps and the available drawing tools. Second, the implementation phase will explain the process used to extract the topics of a set of verses by recognizing the keywords and root recognitions. Finally, the evaluation phase will cover the testing of the algorithm and the evaluation of the generated results.

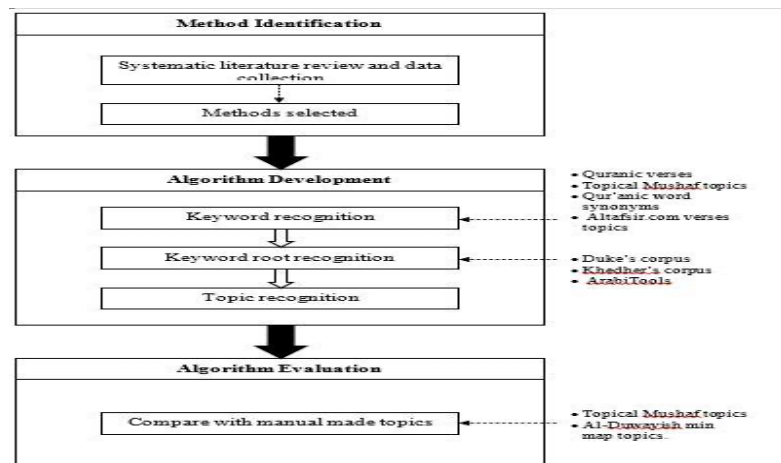


Fig 1. Graphical view of methodology framework

#### Phase 1: Data Collection

This phase consists of two sub-phases, which are finding the problem and doing a literature review. The problem as defined in the problem statement is mind maps topics that are generated manually for the Holy Quran. The aim of the study is to automate this process and achieving this aim will have a positive impact on the understanding of the Holy Quran.

The idea of getting the general topics of a chapter in the Holy Quran is to find the topics of its verses. After getting the topics of all different sets of verses of a chapter, the general topic of that chapter can be identified. Same technique can be used to find the general topic(s) of the whole Holy Quran. To achieve this phase of data collection, the researcher uses some data resources as described in the next sub-section. The researcher also cited the drawing guidelines of mind map and reviewed some drawing tools.

*Phase 2: Implementation*

The implementation phase consists of three primary processes as shown in (Figure 2). They are keywords recognition, keywords root retrieval and topic recognition. This is an important phase because it answers two research questions and objectives that are relegated to keyword recognition and topic recognition.

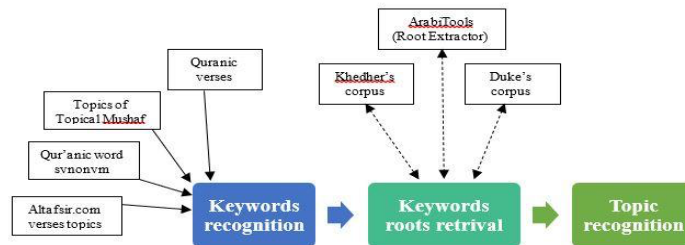


Fig2. Implementation processes

*Phase 3: Evaluation and Testing*

The evaluation phase will consider the quality and the correctness of the extracted topics. The evaluation phase will start by validating the results of the proposed algorithm. This phase will use Al-Duwayish (2017) mind maps topics and the Topical Mushaf topics of Makhlouf (2013), because they are created manually and reviewed and validated by an expert human in this domain. Therefore, the error rate is much lesser than the automated process. If the compression did not come up with similar results, then the algorithm will be investigated to find the problem and enhance it until the results are satisfactory. The proposed target of the error rate is 30%.

**4 The Proposed Algorithms**

The algorithm that will be used to extract the topics of the mind maps is composed of four smaller algorithms. They are extracting root frequency from the verses, extracting the root frequency of qur'anic word synonym's encyclopedia, extracting the frequency of the roots from the verses subjects of Altafsir.com website and finally, finding the top repeated root among the mentioned extraction methods. These algorithms will retrieve the selected verses topics.

*4.1 Algorithm Implementation*

Since the algorithm is ready, the researcher can write the code based on it. Any programming language can be used to execute the algorithm steps. Due to its ease of use, the researcher uses PHP scripting language with HTML and CSS. These languages are used in web development. PHP is capable of connecting a variety of databases including MySQL database, which is used in this research to host the QAC data and other tables.

#### 4.2 Implementation Database Tables

To implement this algorithm some tables, need to be created and used. These tables are as follow:

- Corpus table: contain the QAC data.
- Sura table: contain the details of the Suwar of the Holy Quran.
- Aya table: contain all verses of the Holy Quran
- Duwayish table: contain topic distribution based on Al-Duwayish (2017) mind map of Surat Al-Baqarah.
- Topic: contain topic distribution based on the Topical Mushaf of Makhoulf (2013) of Surat Al-Baqarah.
- Root table: contain the word and its root, which was retrieved from ArabiTools website of Salhi (2018).
- Tafsir table: contain all of the topics of every verse of Surat Al-Baqarah.
- Wordsynonyms table: contain the word and its synonyms according to the Encyclopedia of the word and its synonyms in the Holy Quran of Kubaysi (2017).

#### 4.3 The Implementation Code

The algorithms were implemented using PHP, HTML and CSS scripts. HTML and CSS was used to structure and style the result. PHP is the main language which was used to apply the steps mentioned in the algorithms as it will connect to the database, read the data from the tables, and process them.

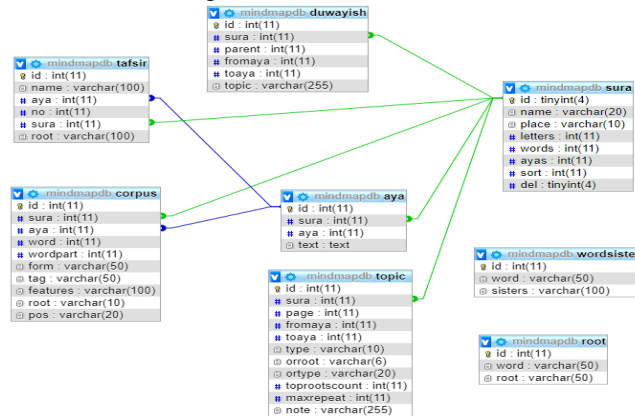


Fig3. Database table and the relationships between them.

Word	id	Sura	Aya	Word	Wordpart	Form	Tag	BW Root	Ar Root	Pos
الكتب	52	2	2	2		kitabu	N	ktb	كتب	N
رئت	54	2	2	4	1	rayoba	N	ryb	رئب	N
هدى	57	2	2	6	1	hudfy	N	hdy	هدى	N
للمؤمنين	60	2	2	7	3	mut-ayma	N	wqy	وقى	N

Topic No:1 [purple] : 2-1 : البقرة

Check for word sister:

Root	Frequency	Word Sisters
كتب	1	كتاب سجل
رئب	1	خيرة سلك
هدى	1	
وقى	1	

Check for topics at attafsir.com website:

Verses	Topic	Roots
1	القرآن	قرأ
2	أسماء القرآن	يسمى قرأ
2	الزئب	رئب
2	الله	له
2	القرآن	قرأ
2	القرآن	قرأ
2	القرآن	قرأ
2	التفقه والانفاق	تفق تفرق

Fig4. Implementation code result

The code is full of comments that enable the user to know each starting and ending of the algorithms. The code is set to run for the first topic of the Topical Mushaf, which

cover the first two verses of Surat Al-Baqarah. This code has been applied to all topics of Topical Mushaf and all topics of Al-Duwayish mind maps topics.

## 5 Results

This research has successfully attempted to extract the topics of the Holy Quran verses using a proposed algorithm to facilitate the automation of the mind map generation of the Holy Quran. It uses a novel approach in mind map generation by using keyword root instead of the word itself to group the similar words. Moreover, it presents the available resource to do the evaluation and the comparison between the results of the automatic and the manual mind map. This algorithm is composed of four smaller algorithms, which are used to extract the frequent word roots in the qur'anic verses, extract the frequent word roots of the qur'anic word synonyms, frequent word roots of the subjects in Altafsir.com website and the overall most frequent root.

<b>Algorithm 1: Extracting Frequent Roots in Verses</b>	
1:	range $\leftarrow$ Get a verses sets(From Aya, To Aya)
2:	<b>For Each</b> verse in range <b>do</b>
3:	verse $\leftarrow$ Get verse details
4:	<b>For Each</b> word in verse <b>do</b>
5:	word_parts $\leftarrow$ Get all word parts of word
6:	<b>For Each</b> word_part in word_parts <b>do</b>
7:	<b>If</b> (word_part is noun or verb) <b>then</b>
8:	root $\leftarrow$ Get root of word_part
9:	Increment verse_roots_array[root] +1
10:	<b>End If</b>
11:	<b>End For Each</b>
12:	<b>End For Each</b>
13:	<b>End For Each</b>
14:	<b>Return</b> verse_roots_array

Fig5 Extracting Frequent Roots in Verses

<b>Algorithm 2: Extracting Frequent Roots using Word Synonyms</b>	
<b>Input</b> verse_roots_array from algorithm 1	
1:	<b>For Each</b> root in verse_roots_array <b>do</b>
2:	word_synonyms $\leftarrow$ Get all word synonyms of the current root
3:	<b>For Each</b> word_synonym in word_synonyms <b>do</b>
4:	root $\leftarrow$ Get root of word_synonym
5:	Increment synonyms_root_array[root] +1
6:	<b>End For Each</b>
7:	<b>End For Each</b>
8:	<b>Return</b> synonyms_root_array

Fig6. Extracting Frequent Roots using Word Synonyms

<b>Algorithm 3: Extracting Frequent Roots using Altafsir.com Subjects</b>	
1:	range $\leftarrow$ Get a verses sets(From Aya, To Aya)
2:	<b>For Each</b> verse in range <b>do</b>
3:	verse $\leftarrow$ Get verse details
4:	<b>For Each</b> word in verse <b>do</b>
5:	topics $\leftarrow$ Get verse topics
6:	<b>For Each</b> topic in topics <b>do</b>
7:	Remove extra words from the topic
8:	<b>For Each</b> word in topic <b>do</b>
9:	root $\leftarrow$ Get root of word
10:	Increment subject_word_root_array[root] +1
11:	<b>End For Each</b>
12:	<b>End For Each</b>
13:	<b>End For Each</b>
14:	<b>End For Each</b>
15:	<b>Return</b> subject_word_root_array

Fig7 .Extracting Frequent Roots using Altafsir.com Subjects

<b>Algorithm 4: Finding the most frequent root</b>	
<b>Input</b> verse_roots_array from Algorithm 1, synonyms_root_array from Algorithm 2, subject_word_root_array from Algorithm 3	
1:	range ← Get a verses sets(From Aya, To Aya)
2:	<b>For Each</b> root in verse_roots_array <b>do</b>
3:	Increment all_roots_array[root] + ← verse_root_array[root]
4:	<b>End For Each</b>
5:	<b>For Each</b> root in synonyms_roots_array <b>do</b>
6:	Increment all_roots_array[root] + ← synonyms_root_array[root]
7:	<b>End For Each</b>
8:	<b>For Each</b> root in subject_word_roots_array <b>do</b>
9:	Increment all_roots_array[root] + ← subject_word_root_array[root]
10:	<b>End For Each</b>
11:	Sort all_roots_array in descending order
12:	top_root ← Get the top roots from all_roots_array
13:	verses_topics ← Get the topics that are associated with the top_root
14:	<b>Return</b> verses_topics

Fig8. Finding the most frequent root

### 5.1 Algorithm Results

After applying the extraction technique of the topics, which is mentioned in the implementation chapter, all topics of the verses sets were found. These selection types are described as follow:

- **Repetition:** The root was selected based on the maximum repetition count of this root. That means there is only one root that got the maximum repetition value and no other root count tie with it.
- **Topic:** In these verses set, there are more than one root tie to the maximum repeated roots. Therefore, the second criterion was added to calculate the new weight of these roots by adding the repeated roots in the topic description of the Topical Mushaf.
- **Meaning:** In these verses set, there are more than on root tie to the maximum repeated roots. The second criterion is used but still does not solve the problem. The selection of the best root will be selected manually by checking the meaning of the verses.

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As it appears in this figure, almost half of the topic roots are selected by the repetition method. Only a quarter of the results uses the topics section at the Topical Mushaf and the last quarter is using the meaning method, which is the manual method. This indicate that the algorithm gives decent automatic results compared to the manual results.

In addition to these results, the researcher also has found the top repeated roots in Surat Al-Baqarah as an alternative way to find the topic of the whole surah using the top repeated roots. Surat Al-Baqarah has 567 unique roots as they presented in (Table 1). The top repeated root is (قول) which is repeated 139 times. Then, the root (علم) which is repeated 89 times. These top roots can give indication of the topics of the second chapter in the Holy Quran.

## Automatic Mind Maps Generation for The Holy Quran

Sura	Page	From Aya	To Aya	Topic Color	Topic No.	Topic Root	Topic Root Selection Type	Top Tie Repeated Roots	Max Root Repeat Count
2	2	1	2	purple	1	كتب	topic	4	1
2	2	3	5	green	2	امن	topic	2	2
2	3	6	7	purple	3	نذر	repetition	1	2
2	3	8	16	yellow	4	امن	repetition	1	9
2	4	17	20	purple	5	ظلم	meaning	2	3
2	4	21	22	blue	6	جعل	meaning	2	2
2	4	23	24	red	7	جعل	meaning	2	2
2	5	25	25	green	8	رزق	repetition	1	3
2	5	26	27	purple	9	مثل	topic	3	2
2	5	28	29	blue	10	سوي	meaning	4	2
2	6	30	33	yellow	11	علم	meaning	2	8

Fig9. Verses sets topic root

No.	Root	Count
1	قول	139
2	علم	89
3	امن	81
4	كون	78
5	اني	54
6	ريب	49
7	كتب	48
8	نذر	44
9	شيا	43

Fig10. Top ten repeated roots in Surat Al-Baqarah

The algorithm has a bit of a manual process that require an individual to select the closest match to the topic of the selected verses. Therefore, it has been improved by adding other sources of knowledge that was done by other researchers. These sources are the repeated roots of the word synonyms and the roots of the topics from Altafsir.com website. This improvement has solved the need to the manual selection process of the topic and promote the automatic generation of the topic of the verses and make it more accurate. The result as it appears in (Table 1) shows the topic sets based on the Topical Mushaf, top roots count, maximum roots count and the topics related to the top roots.

## 6 Conclusion

This research attempted to overcome the problem of creating mind map manually of the Holy Quran. There are many researchers that studied mind maps in various filed. Also, some researchers conducted research on creating mind maps of the Holy Quran with a manual method for the second chapter (Surat Al-Baqara) and found a positive impact on students learning and understanding. Other researchers worked on the automatic creation of mind maps for English, Croatian and Indonesian languages. These mind maps generation helped them to summaries the input and present the data in an easy pictorial representation. Although, none of the previous research emphasize on making automatic mind map of the Holy Quran.

This research has successfully attempted to extract the topics of the Holy Quran verses using a proposed algorithm to facilitate the automation of the mind map generation of the Holy Quran. The objective was achieved by getting the most frequent root of the qur'anic words, Topical Mushaf topics, word synonyms and Altafsir.com website topic words. The last objective was to use an effective method of evaluation that will measure the efficiency of the algorithm. The evaluation process has validated the results of the proposed algorithm using Al-Duwayish (2017) mind maps topics and the Topical Mushaf topics of Makhlouf (2013) as expert human in this domain created by them. The algorithm has been implemented and it focus on the use of the words root of the qur'anic words which are retrieved from Quranic Arabic Corpus and included other sources like the topics of the verses mentioned in Altafsir.com website and the Encyclopedia of the word and its synonyms in the Holy Quran. The algorithm results were very good, and



they were validated with other work of expert scholars in the same field of qur'anic topics. The error rate of the proposed algorithm is less than the proposed limit. It is 24% of 30% for short ranges and exceeded the limit by 5% in the long range of the qur'anic verses.

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