

## CHAPTER 7

### CONCLUSIONS AND FUTURE WORKS

#### 7.1. Conclusions

In this chapter, conclusions are derived from the findings of this study on the experiences of performing speech profiling. Speech profiling system is one of the speech processing technique that deals with interactions between human voice and machines (computers) and analyse significant amount of data for better understanding. The system is widely used in various type of major languages around the globe due to common misunderstanding in interpreting the original meaning. This thesis described the use of DSPs as tools to analyze the complexity of such processing. Among other methods that has gained significance research for the melodious Quranic language over the decades is Automatic Speech Recognition system (Kirchhoff, 2004). The development of Arabic recognition system may appear difficult and quite challenging since the Quran is in Arabic. Furthermore, the way in which any Quranic verse is recited can differ from one person to another.

Audio feature extraction play important role in processing the speech signals. In this research, the extraction features is the key process that give significant impact to the whole profiling system. QMR are considered as a complex speech signal and the audio features contained need to be extract and analyse for the purpose of understanding the characteristics of the signal components. The proposed framework is able to extract strong features that characterise the complex nature of melodious audio speech signals using audio feature extractions i.e. Spectral Descriptors and MFCC with W-DFT.

The overall process of profiling the maqamat features, which consist of three stages as shown in Figure 7.1. First stage is the data collection of the 32 samples of pre-recorded QMR audio files for each of seven (7) types of Maqamat. That would give the total of 242 audio samples with average duration of 10-12s. The data is divided into two sets; primary datasets which impose as training data due to its acoustic elements contained in full cycle of *tabaqat* (pitch and timbre) recitation. The remaining data is consider as secondary datasets for testing and evaluation purposes. Then it followed with second stage by extracting the maqamat features using existing and enhanced cepstral analysis based on warping function. 9 sets of audio features from spectral descriptors algorithm and 2 sets are extracted from MFCC and enhanced W-DFT. The framework managed to detect the mean of spectral envelope and spectral descriptors as significant audio features which used as entities for attributes tagging and rule matching. This process had semantically recognize the input data by rolled out some rules and attributes tagging in developing newly proposed ontology to be facilitate for the final steps. The final stage is performing the semantic analysis based on Maqamat Ontology with attribute tagging and rule matching for the insight QMR knowledge base construction.

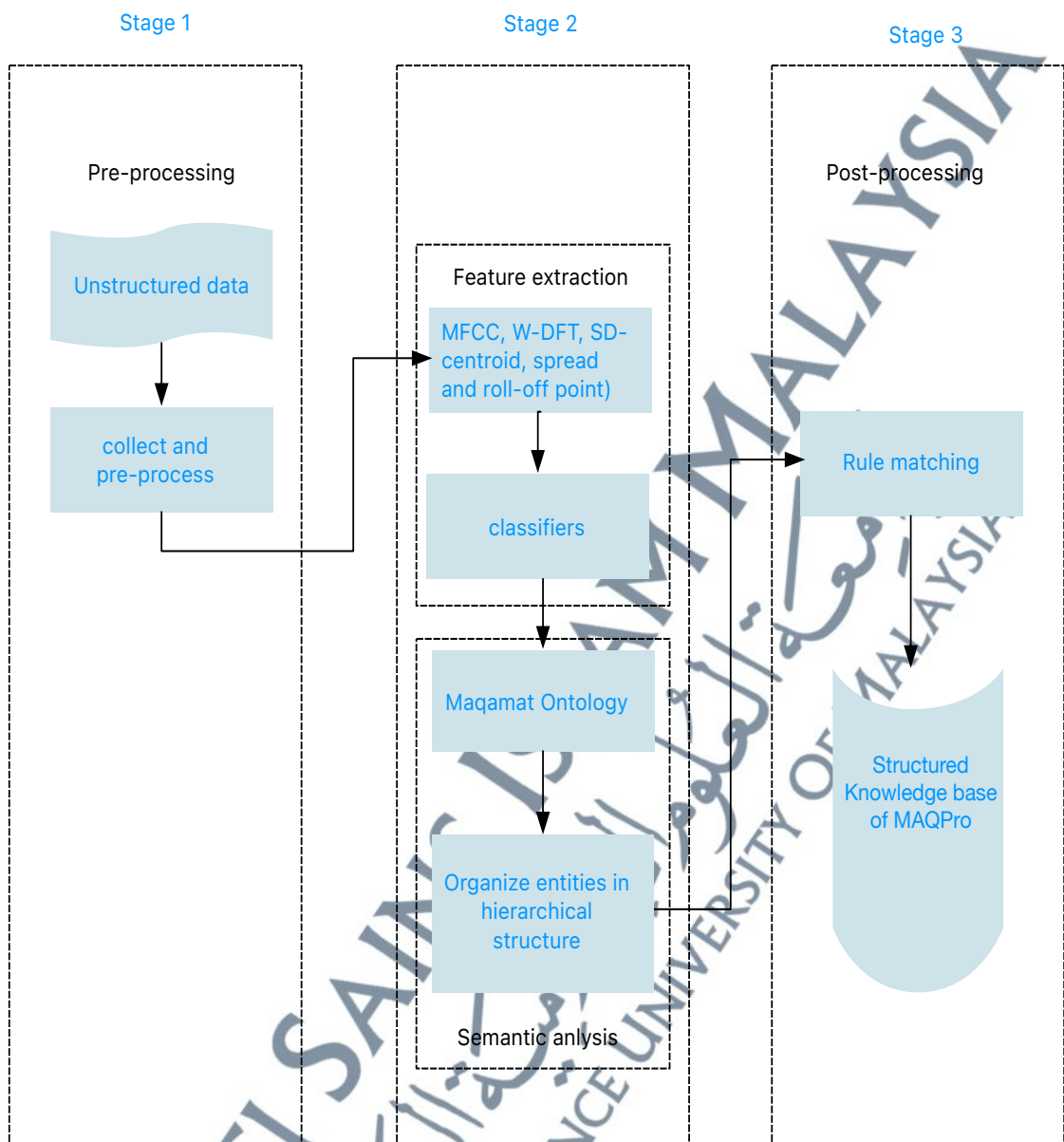


Figure 7.1 The overall process of Maqamat profiling technique

## 7.2. Achievements

This section highlights three (3) major achievements of the thesis, which are the following: -

### 1. Maqamat Profiling Technique

The framework is designed to implement a systematic approach of Maqamat Profiling technique based on extracted ontological audio features contained in selected surah of Quranic verses. It can be used to improve the understanding on the characteristics of the maqamat content and assist in identifying weaknesses of the pronunciation in the recitation of the Qur'anic verses by the reciters.

### 2. Maqamat ontology for QMR knowledge base

The audio features extracted from QMR has deduce a new ontology based on the semantic knowledge from the maqamat features. The ontology provides a knowledge representation model that supports intelligent audio editing systems to facilitate information management in the studio through the collection of production information for archival, search and educational applications for the development of an insight QMR knowledge base.

### 3. Standard of profiles for QMR

Setting a set of standard and guidelines for QMR's experts and learners to develop more systematic and professional learning module in maqamat. This standard will lead to a more systematic and appropriate when reciting the Quranic content without specific theme or expressions.

### 7.3. Contributions to Knowledge

There are some key contributions which reflected the broad range of activities and outcomes achieved throughout this study related to knowledge and research discipline. The contributions are presented as following:

1. Enhancement of MFCC

Enhancing the conventional MFCC by replacing the mel filterbank phase with direct warping function with uniformly warped DFT (W-DFT). The W-DFT algorithm has significantly give smoother signal pattern as compare to conventional MFCC. (Chapter 4).

2. Ontology based on audio engineering notation and maqamat features

The proposed ontology comprises of components which can be used to realize the idea of intelligent audio editing using semantic audio introduced in this work. The model is developed for the ease of future editing and modification based on any type of QMR (Chapter 5).

### 7.4. Limitations

They are the shortcomings, conditions or influences that cannot be controlled by that give restrictions on methodology and conclusions. Any limitations that might influence the results should be mentioned here. The limitations of this research are briefly described as follows:

1. Limited samples for QMR datasets

The samples of QMR are collected only from 28 pre-selected surah in the final chapter of Quran and captured from the voice of only one single male professional reciter.

2. Pre-recorded audio data

The data collected from QMR are pre-recorded in studio recording. The proposed system does not facilitate for real-time data such as captured from microphone as audio input.

3. Time constraint

The extraction method in the proposed system has a time constraint on the execution of QMR datasets. It only allowed to execute to not more than 35 second.

4. Web database with studio quality

The performances are not well tested with real-world data due to existing data from web are not equipped with standard quality of audio editing tool.

## 7.5. Future Works

The limitations described in Section 7.4 can be addressed as future works to improve the efficiency of the proposed image segmentation system. Further future works are described as follows:

1. Bigger sample of datasets

QMR should include more surahs covered, type of maqamat, reciters' gender and level of expertise, and different type of machine specifications.

2. Real-time audio data

In future the system should be able to facilitate a real-time capturing audio data for feature extraction process.

3. Unlimited time duration

The proposed system should be able to simulate the extraction process with unlimited time duration recording.

4. Software tools

The technique should be able to establish a system web-based audio tool for implementation and be able to integrate to other existing web database with different background of sound quality.

5. Potential areas

Further areas of potential expansion, new ideas, and new areas of research for supporting Quranic learning for the Muslim community are also explored and identified.