

**TAJWEED CLASSIFICATION USING NATURAL  
LANGUAGE PROCESSING**

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Bachelor of Science in Computer Science and Engineering.

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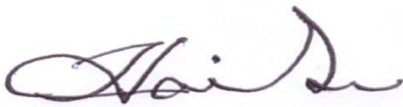
**DHAKA, BANGLADESH**

**OCTOBER 30, 2021**

**APPROVAL**

This Project titled “**HOLY QURAN RECITATION RECOGNITION USING NLP**”, submitted by Akm Sifath Ullah, Md Sazzad Hossain And Mazharul Islam Hridoy to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 18<sup>TH</sup> January 2022.

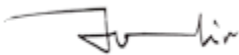
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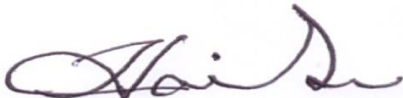
**DECLARATION**

We hereby declare that this project has been done by us under the supervision of **SM Aminul Haque Associate Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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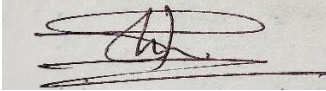
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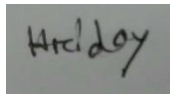
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## ABSTRACT

Holy Quran Recitation Learning using Natural language Processing is a research-based project and the main goal of the project is to help Muslims to learn the Quran more efficiently. While reciting the Holy Quran, Ahkam Al-Tajweed (Quranic Recitation Rules) which are the articulation rules of the Quran must be applied properly. Various efforts were made by previous systems which were mostly based on pronunciation rules. Little effort has been made on the advanced Tajweed rules which are related to the rhythmic recitation of the Quran such as where to “prolong” and “change” certain letters. This paper addresses the problem of identifying the correct usage of the Tajweed rule in the entire Quran. Specifically, we focus on the Iqlaab rule of Tajweed faced by novice reciters. We built an in-house dataset for our problem which particularly had all the audios of the IQLAAB rule which contained both the right and wrong pronunciation of the rule. During feature extraction, we used a well-known audio processing algorithm for extracting features which is (MFCC) Mel-frequency Cepstral Coefficient (MFCC). Then we used the 2 types of algorithms which are artificial neural networks(ANN) and Long Short-Term Memory (LSTM) for classification. Our highest accuracy is 86%. This accuracy was achieved by Long Short-Term Memory (LSTM).

## Table of Contents

<i>BOARD OF EXAMINERS</i>	<i>i</i>
<i>DECLARATION</i>	<i>ii</i>
<i>ACKNOWLEDGEMENT</i>	<i>iv</i>
<i>ABSTRACT</i>	<i>v</i>
<b>CHAPTER</b>	<b>1</b>
<b>CHAPTER 1</b>	<b>1</b>
<i>1. 1 Introduction :</i>	<i>1</i>
<i>1. 2 Motivation:</i>	<i>2</i>
<i>1. 3 Rationale of the Study:</i>	<i>2</i>
<i>1. 4 Research Questions:</i>	<i>3</i>
<i>1. 5 Expected Output:</i>	<i>4</i>
<i>1. 6 Project Management and Finance:</i>	<i>4</i>
<i>1. 7 Report Layout:</i>	<i>5</i>
<b>Chapter 2: Background</b>	<b>5</b>
<i>2. 1 Preliminaries/Terminologies:</i>	<i>5</i>
<i>2. 2 Related Works:</i>	<i>6</i>
<i>2. 3 Comparative Analysis and Summary:</i>	<i>7</i>
<i>2. 4 Scope of the Problem:</i>	<i>11</i>
<i>2. 5 Challenges</i>	<i>11</i>
<b>CHAPTER 3: Research Methodology</b>	<b>12</b>
<i>3. 1 Research Subject and Instrumentation</i>	<i>12</i>
<i>3. 2 Data Collection Procedure/Dataset Utilized</i>	<i>13</i>
<i>3. 3 Proposed Methodology/Applied Mechanism</i>	<i>14</i>
<i>3. 4 IMPLEMENTATION REQUIREMENTS</i>	<i>21</i>
<b>CHAPTER 4: EXPERIMENTAL RESULTS AND DISCUSSION</b>	<b>22</b>
<i>4. 1 EXPERIMENTAL SETUP</i>	<i>22</i>
<i>4. 2 EXPERIMENTAL RESULTS &amp; ANALYSIS</i>	<i>23</i>

<i>4.3 Discussion</i>	24
<b>CHAPTER 5: Impact on Society and Sustainability</b>	<b>24</b>
<i>5.1 Impact on Society:</i>	25
<i>5.2 Ethical Aspects:</i>	26
<i>5.3 Sustainability Plan:</i>	27
<b>Chapter 6: Summary, Conclusion and Implication of Further Future</b>	<b>27</b>
<i>6.1 Summary of The Study</i>	28
<i>6.2 Conclusion</i>	28
<i>6.3 Implication for Further Study</i>	29
<b>References</b>	<b>31</b>

## List of Tables

<b>Table</b>	<b>Page</b>
Table 1:SUMMARY OF RELATED PAPER WORKS.	7
Table 2 :DATASET DISTRIBUTION	13
Table 3:EXAMPLE IQLAAB RULE FOR NOON SAAKIN AND TANWEEN .	16
Table 4:EXAMPLE IQLAAB RULE FOR NOON SAAKIN AND TANWEEN .	16

## LIST OF FIGURES

<b>FIGURE</b>	<b>Page</b>
FIGURE 1: BLOCK DIAGRAM OF IQLAAB RULE RECOGNITION MODEL.	14
FIGURE 2 :BLOCK DIAGRAM OF MFCCFEATURE EXTRACTION TECHNIQUE.	15
FIGURE 3:BEFORE(A) AND AFTER(B)EMPHASIS EXAMPLE.	16
FIGURE 4:STRUCTURE OF RECURRENTNEURAL NETWORK.	16
FIGURE 5: STRUCTURE OF ARTIFICIAL NEURAL NETWORK.	16



## CHAPTER

### CHAPTER 1

#### 1. 1 Introduction:

The Quran which is the holy book of Islam was sent by God almighty believed by the Muslims all over the world. Quran composed of 30 chapters. There are in total 6, 236 verses. The verses are divided into 114 parts and they are known as “Surahs”. “Tajweed” is the proper recitation technique of the Quran. Recitation rules (Tajweed) must be taken in consideration for ensuring the exact meaning of the ayats. Among other things the principles of Arabic pronunciation should be known for perfect recitation in a melodious voice.

One of the major issues to learn perfect Tajweed is that an expert is always needed. “Talqeen” is also required, which is a special kind of private tutoring. Such things are not easily available. Different Machine Learning techniques were applied by many researchers to tackle this problem. Researchers developed various computerized systems based on the recordings of various reciters to test the correct usage of Tajweed. However, the considered rules of the existing applications are limited. Also, the number of Quran chapters they covered are not sufficient.

We take into account this problem and approach to build a system which is fairly accurate in classifying noon saakin and tanween's IQLAB rules.

There are several steps in the work.

Firstly, we take advice from experts of Quran recitation about the rule. And different mistakes the students made in particular scenarios in the beginning stages of their recitation.

Secondly, we created a dataset by collecting recordings of audio that contains our specific rule from different ayats of the Quran.

in the Holy Quran that contains the rule. The third step is to apply the feature extraction technique used in the speech processing field.

Finally, after the feature extraction of all the recording; number of classification algorithms were experimented for classification of the Iqlaab rule. Our final model has an accuracy of 86%.

## **1. 2 Motivation:**

But unfortunately, it is not possible for every Muslim to dedicate themselves in full-time study of the Quran.

Our wish is to research and build a system using NLP for everyday Muslims like us. Our system will help Muslims to learn the Quran more effectively, whether he is a student, a working professional, an entrepreneur, an athlete, a politician, a community worker, a stay-at-home mother, or a combination of many things!

With our app users will be achieving recitation and memorization goals easier, faster, and with more enjoyment than ever thought possible.

### **1. 3 Rationale of the Study:**

It is very essential for new Quran learners to understand and apply the basic rules of tajweed while reciting the Holy Quran. If the tajweed rules are not applied correctly during Quran recitation, it can hamper the recitation or even change the meaning of an Ayat of the Quran. Iqlaab is one of the most basic and important rules of tajweed. In recent years much research work has been done on Quranic recitation. But no work has been done on Iqlaab rule of noon sakin and tanween. That's why we are doing our research on Iqlaab rule and making a Natural Language Processing system that can classify Iqlaab rule from a Quranic Ayat.

### **1. 4 Research Questions:**

Here we are discussing some common questions which come to any reader's mind before reading our paper. Literally this question gives a deep overview of our work. It's important to know some things about our work.

We are working with an audio dataset. Audio verses were collected from the internet. We need to extract the specific rules as our dataset from these verses.

Now come to the first question: why do we use MFCCs for feature extraction in our model? MFCCs is a very useful and popular feature extraction technique [20, 21].

In MFCC feature extraction technique, the low frequency region is denoted very well which is more than the region of high frequency. It has the power to compute formants of low frequency regions. This technique is more accurate in recognizing certain patterns which are related to the human voice [22, 23]. That's why MFCC is more suitable for our project.

Second question: Why do we use ANN/RNN? These two classes have great popularity in speech recognition of Arabic [24]. These algorithms have the power to process short term spectral features very well. Previous works show that increasing the duration of utterance improves the speech recognition performance. These classifiers learn in a shorter time than others.

Next one: Why do Iqlaab rule? We don't get any precise work on Iqlaab that's why we decided to work on it.

### **1. 5 Expected Output:**

- The Quran will become more learnable and teachable.
- Improve the recitation quality of the users.
- Achieve more confidence and enjoyment to learn quran
- Helping users to learn and recite the Quran easily.
- Help user in memorization and recitation

### **1. 6 Project Management and Finance:**

Every work has expenditure. For developing purposes, we should expend some money for making the final structure. The expenditure can be categorized in different sections. Because establishing a project can occur in different steps.

First of all, the system where we make the coding. The computer should contain high configuration, especially the ram. Though we used to google Colab, personal storage like a PC was the most suitable for any project. RAM, ROM should also be high quality. So, for making a workstation, we need to spend some money.

On the other hand, for our project we used some free dataset. But if we spend money on collecting dataset, we can increase our project quality. For future implementation, we could not upgrade our project without a paid dataset.

We have a dream to implement our system in a Web version as well as Android version. That's why we need a good developer who can make our project in that form. Already we are doing our best to make a web form but in the long run, we

will need a developer. Hence the developer will ask for his remuneration. So we would have to spend money on developer charges.

Moreover, we will have to face other costs like maintenance, security, storage etc. To sum up, we can say, for making an outstanding project we should spend money. But if we spend money right, we can fix it without spending much money.

### **1. 7 Report Layout:**

In the beginning of this report, a summary of our project is given. It describes the reason we chose to do this project and what type of problem we are trying to solve. After that we also give an introduction of our project with motivation, objective and also the final expected outcome of our project. Then we describe our data collection and preprocessing techniques. And in the later stage of our project we talked about how we classify and achieve our accuracy. With the help of graphs, charts and elaborately discussion we represent the proposed work. Lastly, our discussion is about the future outcome.

And in the last section, we discuss how we can improve it in future and also some references are added.

## **CHAPTER 2: BACKGROUND**

This section will discuss a few things. Firstly, we give some terminologies on our speech recognition system. After that we are going to discuss previous related work and make up a summary. In the summary we give some information like the previous paper's accuracy, feature extraction and classification techniques, paper brief description of the paper. Then we talk about the scope of the problem of our work. And finally, we discuss some challenges we faced while working on this research paper.

## 2. 1 Preliminaries/Terminologies:

Here are some terminologies which we used in this paper.

MFCC: Mel Frequency Cepstral Coefficients

FFT: Fast Fourier Transform

ASR: Automatic Speech Recognition

## 2. 2 Related Works:

Recently, many researchers have worked and shown their ability on speech recognition in Arabic. In this section we are going to highlight the works that are only related to the Holy Quran.

The created ASR system [5] helps non-Arabic speakers to learn Quranic recitation correctly. There are various steps of this system. Firstly each word is processed and saved into a codebook by the system separately. Then the system compares the codebook data with the database of correct recitations. The wrong recitations are indicated by the system and correct recitations are shown to the user. Although it considers a small number of Quran verses, it gives 92% accuracy.

The authors [6] built a system which is capable of determining one correct rule among eight tajweed rules from audio recording of Quran verses. The considered tajweed rules are Edgam Meem, Ikhfa Meem , Ahkam Lam (two rules) and Edgam Noon (four rules). The classification problem involves sixteen classes having the correct and incorrect portion in each rule.

In [7], the authors created a deep learning based Automatic Speech Recognition system which can classify the Arabic alphabet. Different neural networks like deep convolutional neural network , BLSTM ,recurrent neural network are used to train and test to classify the alphabet. Among them BLSTM gives an accuracy of 97. 9%.

In [8], a ‘Qalqalah letter pronunciation’ technique draws the mechanism of sound pronunciation of Qalqalah which uses spectrograms. [9] the authors created a system using the MFCC, and support vector machine (SVM) classifier for Qalqalah letters which can detect mispronunciation. Model gives an accuracy of 97.5%.

In[10], a tajweed classification model was proposed which was based on speech processing and ANN. Author used feature extraction technique as (MFCC) and classifier artificial neural network for classification. They focused on the idgham rule of noon sakin and tanween.

In[11] develop a system which identifies reciters. This system is based on the MFCC feature extraction and ANN classification. This system got 91.2% accuracy.

In[12], the authors developed an intelligent tajweed classification system. This system is called E-hafiz. E-hafiz will help a hafiz to correct ayat utterances and also summarizes the mistakes by comparing with an expert's recitation. This system got 92% accuracy.

### 2.3 Comparative Analysis and Summary:

There is a lot of work done in this field related to this topic. From all the previous works has been done related to this topic, some selective papers has been analyzed comparatively and summarized below:

*Table 1: SUMMARY OF RELATED PAPER WORKS.*

<b>AUTHORS, DATE</b>	<b>Experiment Data</b>	<b>SYSTEM DESCRIPTION</b>	<b>Feature Extraction</b>	<b>Classification</b>	<b>Performance</b>

& Ref.s			Algorith m		
Sabba h & Selam at (2014) [1]	93161 samples, where 18994 Quranic words and 74167 are Arabic words	Quranic word detection based on SVM model	Statistical Features	SVM	accuracy got (91.28%),
Tabba a & Souda n (2015) [2]	Collect recitation data from 100 females and 68 males.	Develop a system to detect errors in Quran recitation.	MFCC	HMM and SVM	Accuracy 91.2%
Al- Ayyou b, Damer & Hmeid i	3,071 audio files collected from expert reciters	Develop a system to identify eight Ahkam Al- Tajweed in the entire Quran	MFCC, WPD & HMM- SPL	Bagging, RF, ANN, SVM	Accuracy of the system reached 97. 7%



(2018) [3]					
H. Tabbal, et al. (2006) [4]	Sourate Al-lkhllass:13 Professional reciters and 40 normal reciters	Developed a ASR system to detect Arabic language.	MFCC	HMM	Professional reciters accuracy (90-92)% and Normal reciters accuracy male 90%, female 85%
Asda, T. M. H. (2016) [11]	Dataset collected from internet of five famous reciters which in form of MP3.	Development a system which can recognize Quran reciter.	MFCC	ANN	Accuracy 91.2%

Al-Ayyoub, M., Damer, N. A., & Hmeid, I (2018) [6]	300 audio files idgaam rule recite which recite by two well known sheikh.	Focus on noon sakinah and tanween idgham rule	MFCC	ANN	Levernberg Marquardt training algorithm get highest test accuracy (77.7%)
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#### 2.4 Scope of the Problem:

This work mainly offers to establish a good grammar accuracy for Quran recitation. We know that, without proper pronunciation as well as recitation, Arabic language loses its purity, also proper meaning. So the right recitation techniques are the main aim of our system.

Now-a -days, many learning websites offer many educational resources. Our project only gives the Arabic grammar's resources. Using this system a new learner can achieve the skills which are most important for Quran recitation. Our project mainly works for the rule of Arabic language which is IQLAAB. It is the most important grammar which can provide a pure form of recitation. Moreover, in future we will add numerous grammar rules of Arabic language which can make us a pro reciter. People won't search hither and thither on the internet for collecting grammatical resources. By using our system, they will find everything which is much required for recitation.

For the developing technology era, our project will be the most suitable learning site for Arabic language grammar. It will minimize the lack of learning resources

as well as it will provide a good environment where new or old learners can gain knowledge about Arabic grammar. In a nutshell we can say, The Holy Quran Recitation will be the pioneer for future learning scope where people can find a complete version of resources to increase their recitation ability.

## 2. 5 Challenges

Tajweed rules are more important in Quran recitation because mis-pronunciation can cause different meanings. In researching Tajweed rules, we face some challenges. Here are some mentionable reasons.

Data collection: As we are working on the iqlaab rule of noon saakin and tanween. We need only specifically parts of audio of different verses as our training data which isn't found anywhere online or offline. For this reason, we need to find out the Quran verses of iqlaab rule. After that we need to extract the audio parts of the rule from each verse manually.

Study resources: Tajweed rules recognition topic is the newly most populated one for Quran researchers. Nowadays many things of the automatic speech Recognition (ASR) system are discovered by researchers. As this topic is less researched compared to other topics such as music generic classification, voice recognition etc for this reason resources are less to find out.

Accuracy challenges: In the beginning the accuracy of our model isn't good enough because of noise in the audio dataset.

## CHAPTER 3: RESEARCH METHODOLOGY

In this part we are discussing research methodology. Firstly, we are talking about data collection procedure and dataset type. After that we are going to discuss statistical analysis of our work. Then we give a methodological overview of our work. In that part we discussed how we prepare our dataset for the model. We talk

about MFCC feature extraction techniques and classification algorithms ANN and RNN. At the end we are discussing implementation requirements.

### **3. 1 Research Subject and Instrumentation**

Our research was only dedicated to increase the recitation ability. We mainly work to provide a platform where a user can learn Arabic grammar and according to grammar, a user can learn recitation. Here, the research is only for IqLaab. We can provide a system where wrong IqLaab recitation will detect and provide the correct recitation of IqLaab.

Gathering data on any study is the most important part of any project. So, we need to construct a research instrument. This construction process is known for instrumentation. Gathering data can be held by severe options like questionnaire, interview, observation and so on. Here we collect data online and select data by our own observation. We collect different reciter's audio and collect those portions where IqLaab occurs. Then we classify the right wrong recitation and give a result. Here we use some algorithms for doing our research.

Basically the research always wants to provide a learning environment. People of any ages get benefit through this research. Moreover it helps to increase their reciting ability.

### **3. 2 Data Collection Procedure/Dataset Utilized**

We took our sampling data from online. As we were working on tajweed rules, for that reason we had to extract rules from different Ayat. we took the same Ayat from different reciters and cut the specific part of the Ayat for our rule. Our dataset consists of 40 audios and 20 of them are the correct data of iqlaab rule and another 20 of them are the incorrect data.

*Table 2 :DATASET DISTRIBUTION*

<b>Classification</b>	<b>Audio</b>
Iqlaab (Yes)	20
Other (No)	20

The figure contains the example of noon saakin and tanween respectively. if noon saakin or tanween is followed by arabic letter baa (ب) then noon saakin and tanween has to be read with a gunnah sound like arabic letter meem (م) instead of noon according to the Iqlaab rule.

### **3. 3 Proposed Methodology/Applied Mechanism**

Our work recognizes the iqlaab rule of tanween and noon saakin. This project mainly consists of two parts. The First step involves collection of Ayat of different reciters from online and then extracting the specific rules from the Ayats. Multiple Ayats from multiple reciters are collected to extract rules. We also collected random Ayat which aren't included in tanween and noon saakin rules so that we can collect incorrect data of recitation. These two types of samples are collected as raw data and go for further pre-processing.

After collecting raw data we go to pre-process our audio. we remove noises from our audio data so that we can get only the information which we want. MFCC technique is applied on the pre-processed dataset to extract the feature vectors. These feature vectors are most useful for recognition patterns.

After that , in the second part of our work, we applied RNN-LSTM classification on the extracting feature. In the training phase 'training data' are given to the training model. feature extracting vectors of testing data are given in testing phase and record provides response from model whether it is correct or incorrect.

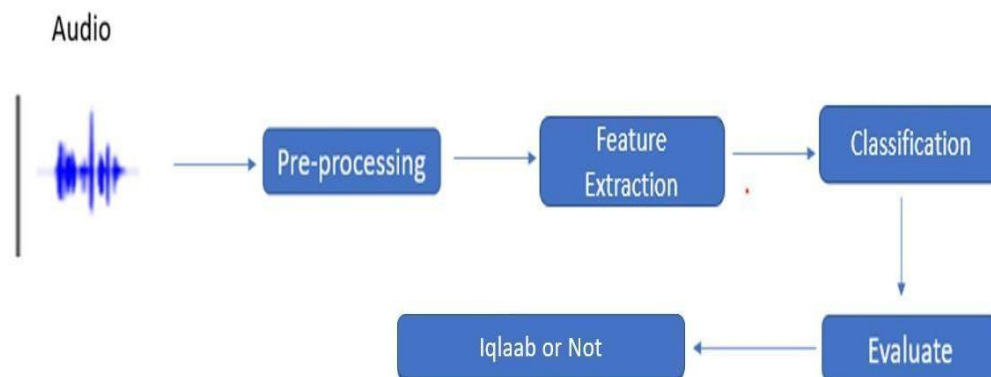


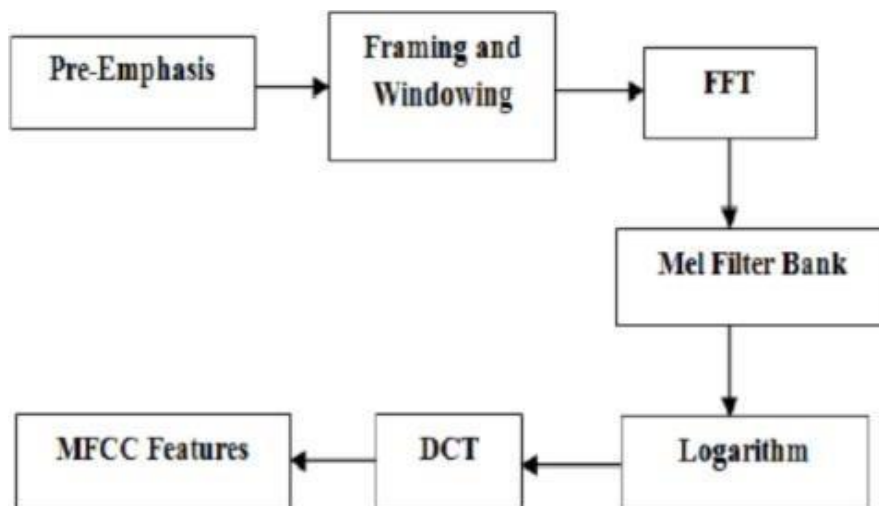
Figure 1: Block diagram of Iqlaab rule recognition model.

### i) Feature Extraction technique

#### Using Mel-Frequency Cepstral Coefficient (MFCC) :

MFCC is mostly used in many automatic speech recognition applications [13]. [14]The study shows that Mel-Frequency Cepstral Coefficient produces the maximum accuracy for analyzing Quran recitation. In audio speech recognition systems ,audio needs to be processed before feature extraction[15]. By doing feature extraction an audio signal can be demonstrated by a predetermined number because it's difficult to deal with the acoustic signal where irrelevant information exists. [16, 17] Feature extraction is a way to transform speech from waveform to parametric form which represents a relatively lesser data rate for further processing[18, 19].

The MFCC implementation block diagram shown in Figure 2A.



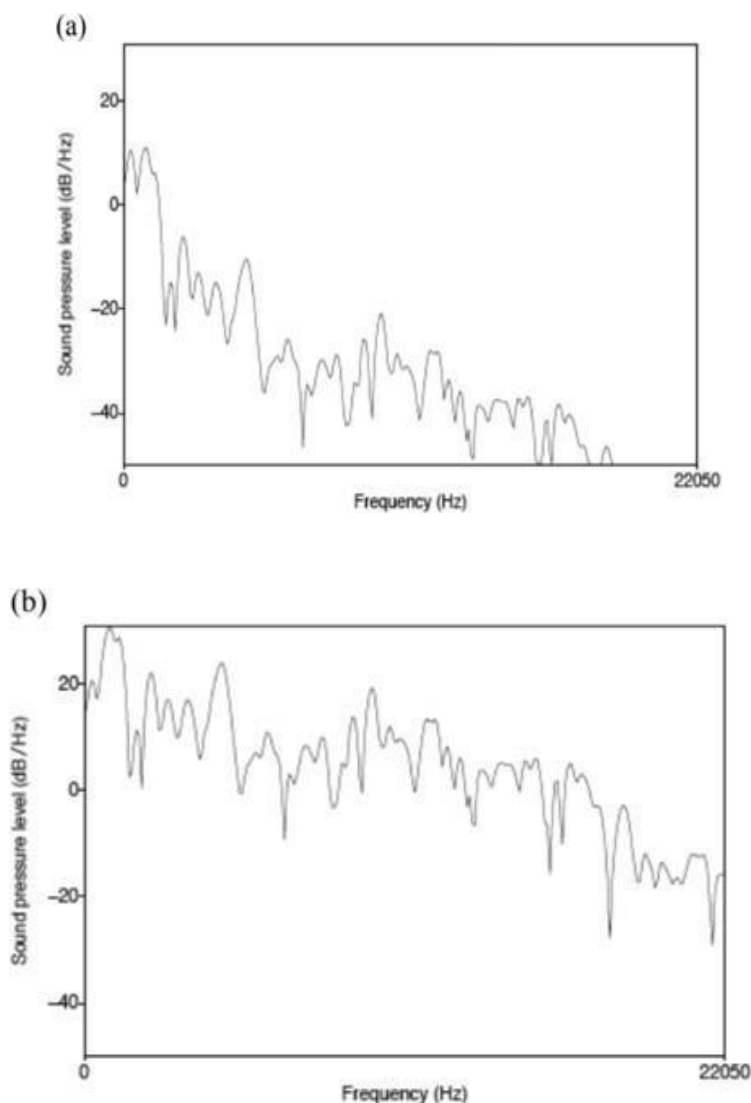
*Figure 2 :BLOCK DIAGRAM OF MFCCFEATURE EXTRACTION TECHNIQUE.*

### **Pre-emphasis -**

During sound production sound frequency gets suppressed. To deal with this issue pre-emphasis is used. pre-emphasis helps to increase the energy of the sound signal at higher frequency. In pre-emphasis, the speech signal goes through a high pass filter which is described in equation (1).

$$() = 1 - *^{-1} \quad (1)$$

where  $b$  is the value of slope of the filter which lies between 0.4 and 1.0.



*Figure 3: BEFORE(A) AND AFTER(B) EMPHASIS EXAMPLE.*

The figure (3A) shows the pre-emphasis effect.

### **Framing -**

The speech signals are segmented with overlap. This segmentation helps to proceed for Fast Fourier Transform (FFT) And overlapping is to reduce losses of information at the end of each frame.



### **Windowing -**

In the frequency domain a long-time signal is split into a short-time signal and this function helps to minimize the effect. There are several types of windows. Such as the Bartlett window, Rectangular window and Hamming window. However, the Hamming window is one of the most used windows for reduction of the side lobe of the Signal.

### **Fast Fourier Transform (FFT) -**

once the pre-processing stage is completed, the vectors of MFCC are acquired for each frame. Then each Frame's FFT is computed in order to obtain its magnitude. Based on the definition FFT and DFT are the same, both have the same transformation output. But they have computational complexity differences.

$$D_k = \sum_{m=0}^{N_m-1} D_m e^{\frac{-j2\pi km}{N_m}} \quad (2)$$

Where  $k = 0, 1, 2, \dots, N_m-1$

### **Mel-filter bank -**

The Mel-filter bank's purpose is to change the resolution of the frequency to a particular frequency range which matches the human ear frequency. Mel-filter bank is needed to strengthen the low frequency components in speech signals lower frequency features. Scale of the Mel-frequency is logarithmic for above 1 kHz and linear for below 1 kHz frequencies. This is because the human hearing is less sensitive at higher frequencies which are above 1 kHz.

Log energy computation - After that the output of the Mel - filter bank is used to compute the logarithm of the square magnitude.

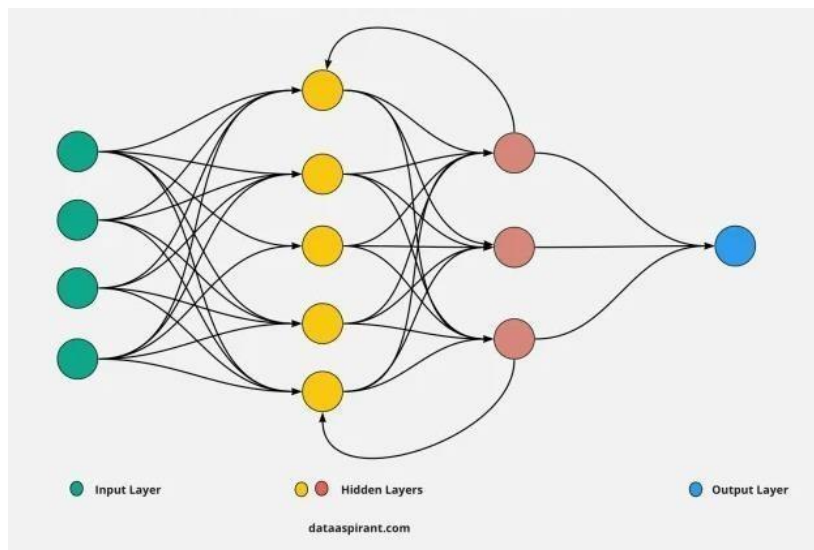
### **ii) Classification**

#### **Recurrent Neural Network (RNN)-**

To work with sequence data RNN is designed. It is very efficient in sequence prediction problems. Among all the Recurrent neural networks, Long short-term memory (LSTM) is a special kind of network.

LSTM overcomes two problems which are vanishing gradients and exploding gradients. It is a unidirectional system that learns from a forward sequence. LSTM modify information by Add and multiply information .

Using the cell states mechanism LSTM passes the information.



*Figure 4: STRUCTURE OF RECURRENT NEURAL NETWORK.*

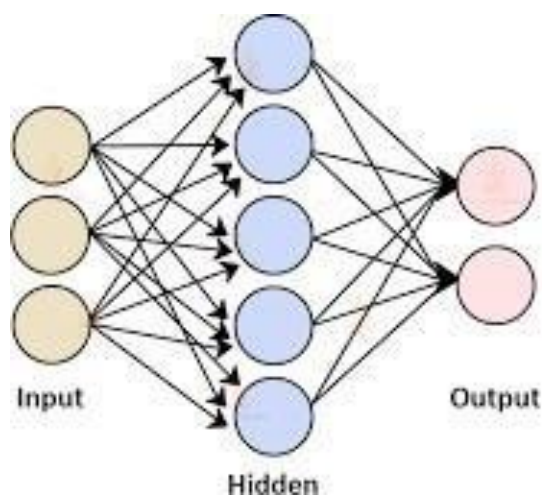
LSTM has the capability to remember or forget information which RNN can not.

The success rate of LSTM is very high when working with sequence data or time series data. Time series data can be words or paragraphs. LSTMs are frequently used for text and speech data, classification problems, and regression predictions.

### **Artificial Neural Network (ANN)-**

Researchers are finding interest in using the ANN ciphering model which is a spontaneous speech classification as well as recognition system. ANN has some

extraordinary features which can approximate complex as well as some problems which are non-linear. unless having to know the mathematical representations of the system. But ANN is not very easy to design. The performance relies on various design's optimization. For instance selecting an optimal network topology where each hidden layer consists of a number of hidden layers and nodes. Moreover, a suitable training algorithm, weight's initial, the rate of learning and so on.



*Figure 5: STRUCTURE OF ARTIFICIAL NEURAL NETWORK.*

Through the work, measuring the ability of the system occurs three different variations of backpropagation training algorithms.

### 3. 4 Implementation Requirements

In this part, we are going to describe the required tools which are used for implementing. Very few parts for any kind of research project are as important as implementation. Without proper implementation, a project loses its value.

The Holy Quran Recitation mainly works as a learning platform. Learners can learn recitation by this system. Since this system works with speech recognition, we had to work with audio files. Audio dataset was the first prerequisite for this system. As we work with some sort of audio data for establishing a model, we need to follow some procedure. First of all, **Feature Extraction** which seems to be the oil of the

project. To implement our model, we have to give input like an extracted feature of audio data. In our implementation, we use the MFCC algorithm for feature extraction of our audio data. For this process we need to know the basics of MFCC algorithm, Spectrogram, First Fourier Transform (FFT). After that we have to apply a classification algorithm on our feature extracted dataset to build our model. For this process we need to research on some classification algorithm namely ANN, RNN - LSTM.

Python is one of the most widely used for Artificial Intelligence. It is the favourite language of all developers as well as researchers. It has some fascinating features and built-in models which can help to make an outstanding automated system. For example, Some well known libraries like numpy, pandas, scikit-learn, spacy, seaborn, matplotlib, NLTK, scipy etc. Python programming language is used widely in our project.

We also used tensorflow and keras which are deep learning frameworks.

## **CHAPTER 4: EXPERIMENTAL RESULTS AND DISCUSSION**

We are discussing experimental setup, experimental results and analysis on our work and discussion on the analysis from this chapter. This chapter is important because we are discussing all the experimental analysis on this chapter.

### **4. 1 Experimental Setup**

In this chapter we are going to talk about experimental setup. We use the colab open source platform for testing and classification purposes. To prepare the dataset we split it 80/20 train test ratio. As for measuring the accuracy of every single classifier we use most useful accuracy measurement techniques namely

tensorboard, precision/recall values, F-score, accuracy and Receiver Operating Characteristic (ROC) curve.

## 4. 2 Experimental Results & Analysis

We collect some Ayat of the Holy Quran. These Ayat contain rules of Iqlaab for example in table (3), which was recited by famous reciters.

*Table 3:EXAMPLE IQLAAB RULE FOR NOON SAAKIN AND TANWEEN .*

(a) Iqlaab rule noon saakin		
(b) Iqlaab rule Tanween		

We discussed experimental results of the model through this chapter. The whole implementation is splitted by two parts such as “Recognition” as well as “ Training” phase.

In the training phase, audio samples are used to extract and train the features.

All the features of samples are extracted in a specific form which is in the form of frequency on Mel Scale by passing the extraction stage.

The average accuracy percentage of The training, validation and testing process for both of the training algorithms varies significantly. The validation dataset is used to evaluate the quality of the training process, in order to avoid overfitting problems where the model tends to memorize the examples.

We used 100 epochs in the training process to improve the training performance. To evaluate the test performance of the model, the test dataset will be used. The best model will be decided based on the test accuracy percentage.

Table (4) proves that our model can perform well on data that it has never seen before.

*Table 4:EXAMPLE IQLAAB RULE FOR NOON SAAKIN AND TANWEEN .*

<b>Classifier</b>	<b>precision</b>	<b>recall</b>	<b>f1-score</b>	<b>Accuracy(%)</b>
RNN-LSTM	0.9	0.83	0.84	86%
ANN	0.8	0.75	0.71	71%

Our model gives an accuracy of 71% with ANN algorithm but the highest accuracy is 86% which was achieved by the RNN-LSTM algorithm.

### 4. 3 Discussion

We used MFCC for feature extraction because among all the feature extraction technique MFCC was always giving the best results for audio feature extraction. Then we use two kinds of classification algorithm which are ANN and RNN-LSTM. Among them RNN-LSTM gives us the highest accuracy of 86% where ANN got 71% accuracy.

## **CHAPTER 5: IMPACT ON SOCIETY AND SUSTAINABILITY**

In this chapter we are discussing the impact of our work on the society, ethical aspects and sustainable plan of our work.

### **5. 1 Impact on Society:**

For Muslims Al Quran is the holiest book which is the last sacred noble book of Allah Almighty. Through the noble angel Jibril, Prophet Muhammad (PBUH) received Al- Quran. However, The Noble Quran is a guide which is spiritual for every Muslims. They can search the things that are about them in the Holy Quran whether they are rich or poor.

Really The Holy Quran is a communication medium between Allah and people because Allah directly addresses every person through this book. That's why this book is an essential media of live or every Muslim. The Holy Quran's words are timeless and always valid. The words of the Quran are deeply relevant to our concerns and experiences. Those words are also integrated fully into our lives.

However, our project aims to teach the correct recitation and identify where the errors occur. From our project, we can detect the error and make the correct use of grammar for Arabic language. The society's members, especially new learners of the Quran, are highly benefited through this project. They can correctly learn Quran recitation by using it. We know that Pronunciation in Arabic language is one of the most important matters. Without correct pronunciation, the meaning will change. Holy Quran Recitation gives us the assurance of correct recitation. This project is focused on the Iklhfa rule on Noon Saaken and Tanween. From this project people can correctly learn this grammar easily. Learning with technology is not an ancient way. Society is good enough for learning with technology. Our project is a

technology which is not very tough for access. People from anywhere, any age and any situation can learn recitation very easily.

They can improve their recitation level very effectively. From this project, we can spread the correct recitation of the Holy Quran. Thus the project gives high impact towards society elaborately to the Members of society.

## **5. 2 Ethical Aspects:**

The Holy Quran Recitation has several ethical aspects. We want to make an easy procedure for learning the recitation of the Quran. People can learn the correct recitation by this project. Pronunciation as well as Recitation is the main feature of our project. Learners can learn very efficiently. Our main aim is to provide a learning environment where any kind of people can learn the Quran in an error free way.

As a Muslim, People need to learn Quran. Because our way of life is declared in the Holy Book. We can pass our life very smoothly if we follow the Quran.

But if we don't recite the Quran correctly, we cannot get the proper meaning. So this is the important term.

Our project focuses on the recitation so that people can learn the correct recitation. Any kind of person can use it to improve his or her recitation. Sometimes people make mistakes when they recite a verse. Thus the verse meaning changes. Through this process they can learn the correct pronunciation of Arabic words as well as Arabic grammar. This project is too easy for use. The GUI of the project is very easy to understand. So All ages can use it with confidence. We just focused on the grammar. So Recitation is our main aspect.

We don't want to do business with this project. Rather than we want to make correct recitation from people anywhere. Anyway, our main motive is to ensure people



recite this noble book in a correct manner. When they are always with the Quran, they can lead a happy life. They can lead very smooth lives. New learners can learn the Quran in the proper way at the beginning stage.

Our main motto to spread the Holy Quran Recitation among all Muslim people. Towards this project, they can become familiar with many famous reciter and can follow their reciting. However, main thing is that, this project is for Islam as well as Muslim.

### **5. 3 Sustainability Plan:**

The sustainability of our project is really appreciable to our society. Our project is for everyone. People who recite the Quran on a daily basis can use it. It is really beneficial for them. Our project is always focused on efficient learning. Many cross checks were done before publishing it. This system is error free and built for the right approach of learning. Besides these, this project is made by collecting many important people reciting verses. These recitations included and identified the accuracy of user recitation based on those recitations. So, there will be no conflict whether the system is accurate or not.

On the other hand, if we think about financial sustainability, we can see there is a cost for using this system. This is free of cost. Users need to install this and can use it very easily. This does not require any internet connection. So, there is no chance of worrying about using this. So people can learn very fast anywhere.

To conclude we can say, It will be a great e-learn platform for learning Quran Recitation.

## **CHAPTER 6: SUMMARY, CONCLUSION AND IMPLICATION OF FURTHER FUTURE**

Through this section we are addressing the summary of our study as well as further study on this work. In the summary of the study section we give the summary of our work. It's a brief description of our work. Then we gave the conclusion of our work. At the end we talk about further study on this work. In the Further study section we discuss what we are planning to do in future.

### **6. 1 Summary of The Study**

Natural Language Processing is a unit of Artificial Intelligence. This technique is used in our Holy Quran Recitation. From this study, we can see the project also worked in recognizing the right term of the Tajweed rule for the whole Quran. Moreover, Iqlaab rules were also focused on the project. A dataset has been made for using Iqlaab Rule. The dataset contained many audio files where right and wrong pronunciation could be seen.

Completing feature extraction, we used an algorithm called the Mel-frequency Cepstral Coefficient (MFCC). Then we classified and so used the Long Short Term Memory (LSTM) algorithm. Basically, this project is based on Recurrent Neural Network. After collecting raw data, we pre-processed audio data and removed noise from it. The MFCC algorithm is used for the pre-processed dataset to extract as well as produce feature vectors. These feature vectors are most useful for recognition patterns.

“Holy Quran Recitation” app is for all ages people. They can learn the Quran where the recitation level will be 100% accurate. This app motivates new learners to learn efficiently. People can learn recitation in any situation whether they are at home, school or offices.

For Muslim, The book “AL-QURAN” is the most purest book. The important thing of the Quran is its recitation. Reciters often make mistakes when they begin to recite this noble book. But if they follow this app they can easily correct it and recite The

Quran very efficiently. Thus the pronunciation of Arabic language does not lose its meaning and the grammar is still correct.

## 6. 2 Conclusion

Holy Quran Recitation works for producing correct recitation. Many well known reciter's recite verses are included into this project. Users can provide their reciting verse and match their accuracy of recitation. This project can access any place without Internet connectivity. The UI/UX is very simple so users from any age can use it easily.

Our Holy Book Quran is most important for us. We always try to follow this noble book for our daily activities. But without proper recitation of its verse it loses its purity. The meaning of the verse becomes another. So, reciting in a correct way is the precaution of this noble book. But sometimes people make mistakes in the conscious or unconscious mind. So, elimination of wrong recitation is the main aim of our project. We specialize in the IqLaab rule of Tajweed faced by novice reciters techniques. We built an in-house dataset for our problem which particularly had all the audios of the IQLAAB rule which contained both the proper and wrong pronunciation of the rule.

During feature extraction, we used a well known audio processing algorithm for extracting features named as MFCC which refers to Mel-frequency Cepstral Coefficient (. Then we used the Long STM (LSTM) algorithm for classification which may be a type of recurrent neural network.

However, our project will become a trustworthy learning platform for each Muslims who wants to gain the correct recitation of the Quran. New learners or any type of learner can be benefited by this project. This project is completely free and very convenient. Using this learning source, people can be highly benefited and increase their recitation skills.

### 6. 3 Implication for Further Study

Every project builder has a duty on a regular basis which is to update his system or work. We are not different towards them. Because if a project doesn't upgrade its functionality according to time, the rate of users will decrease drastically. So regular updates are mandatory for any kind of project.

We are living in an advanced technology era. Every aspect of life is mixed with modern technology. But the technology doesn't sit idly. It has been upgrading and adding features on a regular basis. New programming languages and algorithms are identified day by day.

For further implication we can use new rules which are for recitation grammar of Arabic language. As we worked for Iqlaab in this project, we can use another Arabic language's grammar such as MADD, TAJWEED, GUNNAH and so on. Here we used the algorithm which is named as LSTM refers to Long Short Term Memory . But for the future we have a desire for using new algorithms or existing algorithms like Support Vector Machine, Decision Tree etc.

Most importantly, we have started to work on implementing this project in a web version. We are using a web framework for PYTHON which is called flask. We have a desire to publish this project for all people in a web version. Because the web version will be most convenient for all users. Besides, we have a desire to implement this project in a mobile application.

Hopefully this project will be the best learning platform for muslim for increasing their reciting ability. It will be the trustworthy platform for all learners. People will find much satisfaction while they use this system. The project will be continued for developing and adding new features which will attract new users. The system will provide 100 % service for new learners as well as all ages.

## References

- [1] Sabbah, T. , & Selamat, A. (2014, September). Support vector machine based approach for quranic words detection in online textual content. In 2014 8th. Malaysian Software Engineering Conference (MySEC) (pp. 325-330). IEEE.
- [2]Tabbaa, H. M. A. , & Soudan, B. (2015). Computer-aided training for Quranic recitation. *Procedia-Social and Behavioral Sciences*, 192, 778-787.
- [3]Al-Ayyoub, M. , Damer, N. A. , & Hmeidi, I. (2018). Using deep learning for automatically determining correct application of basic quranic recitation rules. *Int. Arab J. Inf. Technol.* , 15 (3A), 620-625.
- [4]Tabbal, H. , El Falou, W. , & Monla, B. (2006, April). Analysis and implementation of a" Quranic" verses delimitation system in audio files using speech recognition techniques. In 2006 2nd international conference on information & communication technologies (Vol. 2, pp. 2979-2984). IEEE.
- [5]Muhammad, W. M. , Muhammad, R. , Muhammad, A. , & Martinez-Enriquez, A. M. (2010, November). Voice content matching system for quran readers. In 2010 Ninth Mexican International Conference on Artificial Intelligence (pp. 148- 153). IEEE.
- [6]Al-Ayyoub, M. , Damer, N. A. , & Hmeidi, I. (2018). Using deep learning for automatically determining correct application of basic quranic recitation rules. *Int. Arab J. Inf. Technol.* , 15 (3A), 620-625.
- [7]Ziafat, N. , Ahmad, H. F. , Fatima, I. , Zia, M. , Alhumam, A. , & Rajpoot, K. (2021). Correct Pronunciation Detection of the Arabic Alphabet Using Deep Learning. *Applied Sciences*, 11 (6), 2508.

- [8] Altalmas, T. , Ahmad, S. , Sediono, W. , & Hassan, S. S. (2015, September). Quranic Letter Pronunciation Analysis based on Spectrogram Technique: Case Study on Qalqalah Letters. In AIAI Workshops (pp. 14-22).
- [9] Maqsood, M. , Habib, H. A. , Nawaz, T. , & Haider, K. Z. (2016). A complete mispronunciation detection system for Arabic phonemes using SVM. *International Journal of Computer Science and Network Security (IJCSNS)*, 16 (3), 30.
- [10] Ahmad, F. , Yahya, S. Z. , Saad, Z. , & Ahmad, A. R. (2018, November). Tajweed Classification Using Artificial Neural Network. In 2018 International Conference on Smart Communications and Networking (SmartNets) (pp. 1-4). IEEE.
- [11] Asda, T. M. H. , Gunawan, T. S. , Kartiwi, M. , & Mansor, H. (2016). Development of Quran reciter identification system using MFCC and neural network. *Indonesian Journal of Electrical Engineering and Computer Science*, 1 (1), 168-175.
- [12] Muhammad, W. M. , Muhammad, R. , Muhammad, A. , & Martinez-Enriquez, A. M. (2010, November). Voice content matching system for quran readers. In 2010 Ninth Mexican International Conference on Artificial Intelligence (pp. 148- 153). IEEE.
- [13] Tiwari, V. (2010). MFCC and its applications in speaker recognition. *International journal on emerging technologies*, 1 (1), 19-22.
- [14] Ibrahim, N. J. , Idris, M. Y. I. , Razak, Z. , & Rahman, N. N. A. (2013). Automated tajweed checking rules engine for Quranic learning. *Multicultural Education & Technology Journal*.
- [15] Shaneh, M. , & Taheri, A. (2009). Voice command recognition system based on MFCC and VQ algorithms. *World Academy of Science, Engineering and Technology*, 57, 534-538.
- [16] Mosa, G. S. , & Ali, A. A. (2009). Arabic phoneme recognition using hierarchical neural fuzzy petri net and LPC feature extraction. *Signal Processing: An International Journal (SPIJ)*, 3 (5), 161.

- [17] Yousefian, N. , & Analoui, M. (2007). Using radial basis probabilistic neural networks for speech recognition. Proceedings of 3rd international conference on information and knowledge (IKT07), Mashhad, Iran.
- [18] Alim, S. A. , & Rashid, N. K. A. (2018). Some commonly used speech feature extraction algorithms (pp. 2-19). IntechOpen.
- [19] Shah, S. A. A. , ul Asar, A. , & Shaukat, S. F. (2009). Neural network solution for secure interactive voice response. World Applied Sciences Journal, 6 (9), 1264-1269.
- [20] Kumar, P. P. , Vardhan, K. S. N. , & Krishna, K. S. R. (2010). Performance evaluation of MLP for speech recognition in noisy environments using MFCC & wavelets. International Journal of Computer Science & Communication (IJCS), 1 (2), 41-45.
- [21] Alim, S. A. , & Rashid, N. K. A. (2018). Some commonly used speech feature extraction algorithms (pp. 2-19). IntechOpen.
- [22] Ravikumar, K. M. , Reddy, B. , Rajagopal, R. , & Nagaraj, H. (2008). Automatic detection of syllable repetition in read speech for objective assessment of stuttered disfluencies. Proceedings of world academy science, engineering and technology, 36, 270-273.
- [23] Wahyuni, E. S. (2017, November). Arabic speech recognition using MFCC feature extraction and ANN classification. In 2017 2nd International conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE) (pp. 22-25). IEEE.
- [24] He, J. , & Liu, L. (1999, March). Speaker verification performance and the length of test sentence. In 1999 IEEE International Conference on Acoustics, Speech, and Signal Processing. Proceedings. ICASSP99 (Cat. No. 99CH36258) (Vol. 1, pp. 305-308). IEEE.

