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Qur'an Memory Testing System Through Voice Using Mellin And Walsh Transformation

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Abstract
Interest in memorizing the Qur'an is increasing in quantity and experiencing rapid development in the method of memorizing approach. this can be seen by the easy growth of Qur'anictahfidz institutions. Each Qur'an tahfidz institution has its own ways of applying the practice of memorizing the Qur'an to its students, and of course they are guided by a teacher who has mastered the Qur'an by rote. With quite a large number of participants memorizing the Qur'an and the limited ability of teacher services in a short time, new interesting problems have emerged to be raised and applied for efficient and time-saving solutions. So the research proposed is how to build a Qur'an memorization testing system that adopts the teacher's memorization ability to be applied as supervision and testing of the memorization of the Qur'an memorization participants using Mellin and Walsh transformations. memorizing the Qur'an by voice.

Keywords: *Testing, Qur'an, Sound, Mellin's Transformation, Walsh's Transformation*.

1. Introduction

It is undeniable, that interest in memorizing the Qur'an is increasing in quantity and experiencing rapid development in the method of memorizing approaches. this can be seen by the easy growth of Qur'an tahfidz institutions[1]. Each Qur'an tahfidz institution has its own ways of applying the practice of memorizing the Qur'an to its students, and of course they are guided by a teacher who has mastered the Qur'an by rote. With quite a large number of participants memorizing the Qur'an and the limited ability of teacher services in a short time, new interesting problems have emerged to be raised and applied for efficient and time-saving solutions[2]. So the research proposed is how to build a Qur'an memorization testing system that adopts the teacher's memorization ability to be applied as supervision and testing of the memorization of the Qur'an memorization participants[3][4].
In real-time systems, sound testing should be built to the following specifications:

1. The use of efficient computing, this is absolutely necessary for the system for further development such as specifically detecting errors that occur in the reading process, recognizing recitation law patterns, recognizing patterns including nahwu-sharaf studies and others . The use of computations that are too complex in the speech recognition and testing system will greatly affect the speed of performance in the interpretation of sound patterns.
2. High level of system detection accuracy. In this study, the detection rate parameter is used as a reference for measuring system performance.

To build a reliable Qur'an memorization test system that meets the above criteria in real-time, one or more algorithms are needed. Some common algorithms that are often used in sound processing include: Fourier transform, Wavelet, DCT (Discrete Cosine Transform), Hartley transform, Slant transform, and others[4][5]. All algorithms have their own advantages and disadvantages. An algorithm that has an accurate test rate generally has a complex computational complexity, and vice versa, an algorithm that is simple or does not involve a high level of complexity, is generally difficult to obtain a satisfactory level of accuracy, or in other words the system will have a high risk of error. not small.
Problems that arise in the selection of algorithms that are demonstrated into a real-time sound testing system must have two conditions: (1) computationally efficient, and (2) have a reliable level of accuracy, and for that, in the research proposed on this occasion , the researcher used two approaches (1) Mellin Transform, and (2) Walsh Transform. The reason for choosing these two algorithms is that the Mellin Transform represents an efficient algorithm that is exponential and the Walsh Transform represents an algorithm that is non-sinusoidal, or has a basis of -1 and 1 functions[6][7][8].

2. Literature Review

Qur'an is the holy book for Muslims. In addition to the holy book, the Qur'an is also the main source of law in the teachings of Islam. The Qur'an contains the rules of human life in the world which were revealed to the prophet Muhammad SAW through the intercession of the angel Gabriel[2][9].

Signal is a physical quantity that changes according to time, space, or other independent variables. Examples of signals: speech signals, ECG, and EEG. Mathematically, a signal is a function of one or more independent variables. This process is done through signal modeling. An example of a mathematical function of a signal is:

Speech is produced by a collaboration between the lungs (lungs), glottis (with vocal cords) and articulation tract (mouth and nose cavity). Figure 1 shows a cross-section of the human speech organ. To produce a voiced sound, the lungs push air through the epiglottis, the vocal cords vibrate, interrupting air through the airflow and producing a quasi-periodic pressure wave[10][11].

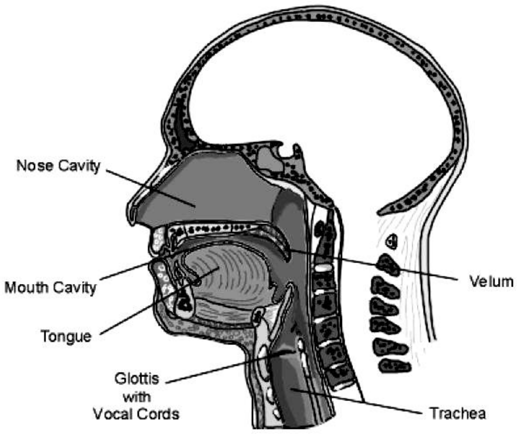


Figure 1. Human speech organs

Pressure impulses are generally referred to as pitch impulses and the frequency of the pressure signal is the pitch frequency or fundamental frequency. In Figure 2 a series of impulses (a function of sound pressure) are generated by the vocal cords for a sound. This is part of the voice signal that defines the speech melody. When we speak at a constant pitch frequency, the sound of the speech signal is monotonous but in the normal case a permanent change in frequency occurs. The pitch frequency variation can be seen in Figure 2[12].

Figure 2. The same series of impulses (sound pressure function)

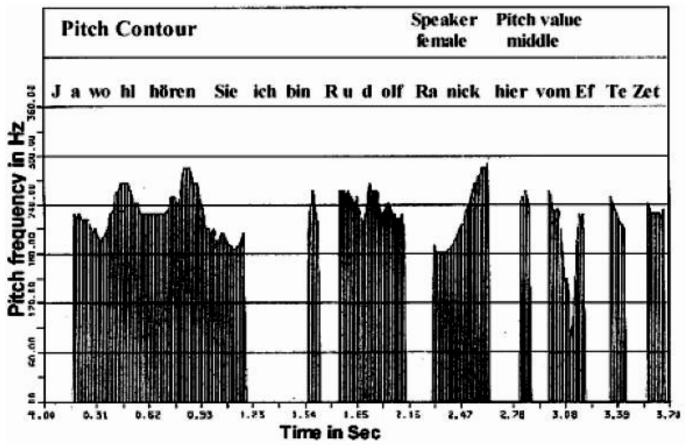
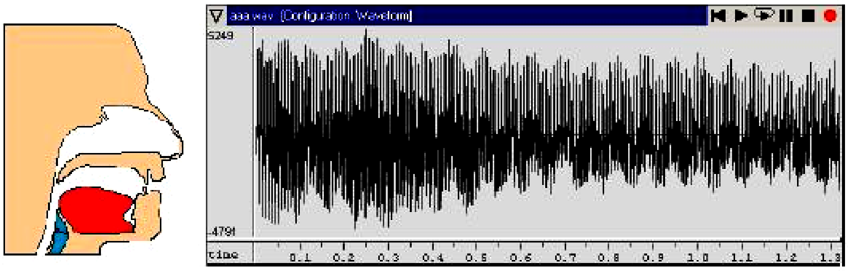


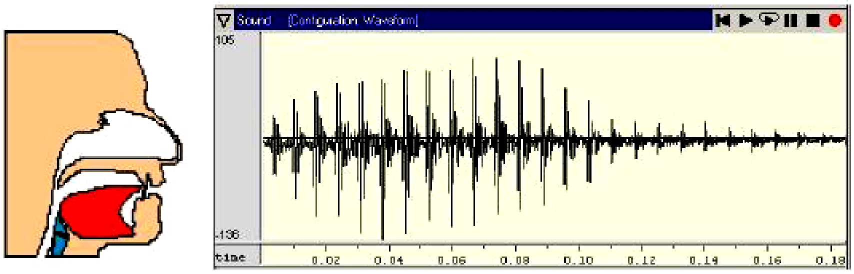
Figure 3. Variation in pitch frequency

Pitch impulses stimulate air in the mouth, and for certain sounds (nasals) also stimulate the nasal cavity. When the cavity resonates, it radiates a sound wave which is a speech signal. The two cavities act as resonators with their own characteristic resonant frequencies, called formant frequencies. At a time when the oral cavity can undergo major changes, we are able to produce a variety of different speech patterns[13][14].

In the case of unvoiced sounds, the excitation of the vocal tract is more like noise. Figure 4 shows the process of producing the sounds of /a/, and /f/. For the time being, the differences in the shape and position of the articulation organs are ignored[14][4].



a. Speech Generation /a/



b. Speech Generation /f/

Figure 4. Sound production process

Speech signal is a signal that varies slowly as a function of time, in this case when observed at a very short duration (5 to 100 milliseconds) its characteristics are still stationary. But when observed for a longer duration (> 1/5 second) the signal characteristics change to reflect the speech sound coming out of the speaker[2][15].

One way to present a speech signal is to display it in three basic conditions, namely silence (S) or a calm state where the speech signal is not produced, unvoice (U) where the vocal cords are not vibrating, and the third is voiced (V) where the vocals are not. The cord vibrates periodically so that it moves air into the esophagus through an acoustic mechanism until it exits the mouth and produces speech signals[16].

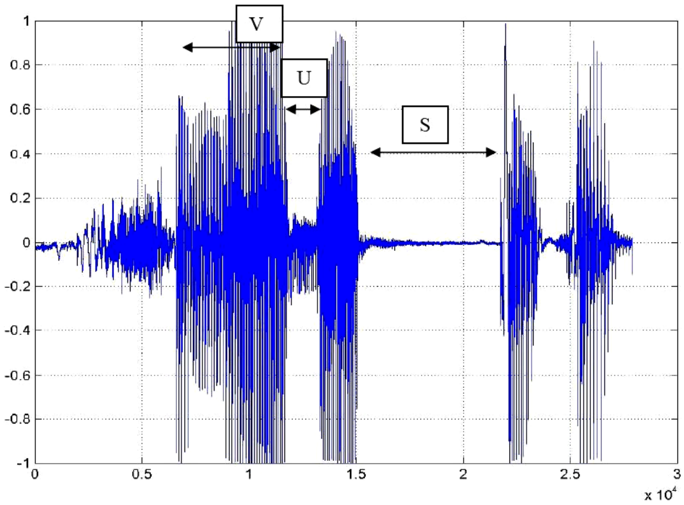


Figure 5. Example of a “Welcome” speech signal

2.1. Mellin's Transformation

Transformation aims to convert digital signals from the time domain into signals in the frequency domain with the following formulation[17][18][19]:

$$\varphi(s) = \int_{x=0}^{N-1} x^{s-1} f(x) dx$$

where

$\varphi(s)$ = Mellin's Transformation

s = signal index in the frequency domain

N = total signal count

x = signal index in time domain

$f(x)$ = signal value.

2.2. Walsh Transformation

Unlike the previously discussed transformations which have a base function of fractions between -1 and 1 (sin and cos), the Walsh transform has non-sinusoidal properties, or in other words, the Walsh transform has a base function of -1 or 1[20][21][22].

The Walsh transform of the f(x) signal is expressed as:

$$W(u) = \frac{1}{N}\sum_{x=0}^{N-1} f(x) \prod_{i=0}^{n-1} (-1)^{b_i(x) b_{n-1-i}(u)}$$

with u=0, 1, 2, ..., N-1 and x=0, 1, 2, ..., N-1, and the value of n follows the rules $N = 2^n$.

For example if N=8 then n=3.

$b_i(x)$ represents the ith bit of binary x, for example x=4 or binary =100, then $b_0(x) = 0$, $b_1(x) = 0$, dan $b_2(x) = 1$. The same goes for $b_i(u)$.

The basic function of the Walsh Transform is expressed by the following formula:

$$g(x,u) = \prod_{i=0}^{n-1} (-1)^{b_i(x) b_{n-1-i}(u)}$$

and from the equation of the basis function (kernel) Walsh Transformation for N=8 will produce the following kernel values:

u \ x	0	1	2	3	4	5	6	7
0	+	+	+	+	+	+	+	+
1	+	+	+	+	-	-	-	-
2	+	+	-	-	+	+	-	-
3	+	+	-	-	-	-	+	+
4	+	-	+	-	+	-	+	-
5	+	-	+	-	-	+	-	+
6	+	-	-	+	+	-	-	+
7	+	-	-	+	-	+	+	-

To get a value in the kernel, then by the following calculation method, for example, take the case of u=1 and x=4, because N=8 then n=3.

biner u=1 adalah 001

binary x=4 is 100

so

$b_0(u) = 1$, $b_1(u) = 0$, dan $b_2(u) = 0$

$b_0(x) = 0$, $b_1(x) = 0$, dan $b_2(x) = 1$

$$g(x,u) = \prod_{i=0}^{n-1} (-1)^{b_i(x) b_{n-1-i}(u)}$$

$$g(4,1) = \prod_{i=0}^{2} (-1)^{b_i(4) b_{n-1-i}(1)}$$

$$g(4,1) = (-1)^{(0)(0)} (-1)^{(0)(0)} (-1)^{(1)(1)} = (-1)^1 = -1$$

Another case let u=4 and x=6,

binary u=4 is 100

binary x=6 is 110

so

$b_0(u) = 0$, $b_1(u) = 0$, dan $b_2(u) = 1$

$b_0(x) = 0$, $b_1(x) = 1$, dan $b_2(x) = 1$

$$g(x,u) = \prod_{i=0}^{n-1} (-1)^{b_i(x) b_{n-1-i}(u)}$$

$$g(6,4) = \prod_{i=0}^{2} (-1)^{b_i(6) b_{n-1-i}(4)}$$

$$g(6,4) = (-1)^{(0)(1)}(-1)^{(1)(0)}(-1)^{(1)(0)} = (-1)^0 = 1$$

Calculate the Walsh transform of the signal f(x)=1, 1, 1, 1, 5, 5, 5, 5

Solution:

$$W(0) = \frac{1}{8}(1+1+1+1+5+5+5+5) = 3$$

$$W(1) = \frac{1}{8}(1+1+1+1-5-5-5-5) = -2$$

$$W(2) = \frac{1}{8}(1+1-1-1+5+5-5-5) = 0$$

$$W(3) = \frac{1}{8}(1+1-1-1-5-5+5+5) = 0$$

$$W(4) = \frac{1}{8}(1-1+1-1+5-5+5-5) = 0$$

$$W(5) = \frac{1}{8}(1-1+1-1-5+5-5+5) = 0$$

$$W(6) = \frac{1}{8}(1-1-1+1+5-5-5+5) = 0$$

$$W(7) = \frac{1}{8}(1-1-1+1-5+5+5-5) = 0$$

then the Walsh transform of the signal f(x)=1, 1, 1, 1, 5, 5, 5, 5 is W(u)=3, -2, 0, 0, 0, 0, 0, 0.

3. Method

The workflow diagram that will be carried out in this study is illustrated in Figure 6.

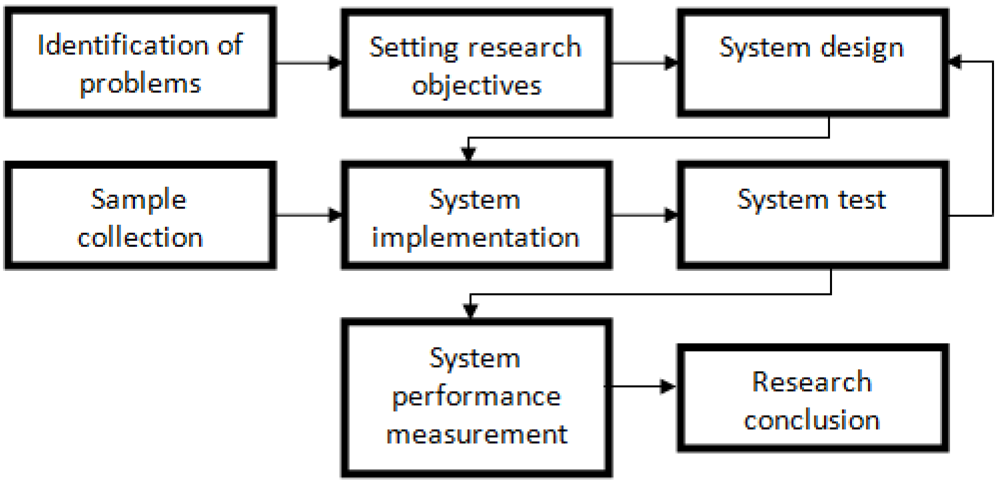


Figure 6. Research workflow in general

The scheme of the Qur'an memorization testing system built in this study is illustrated in Figure 7.

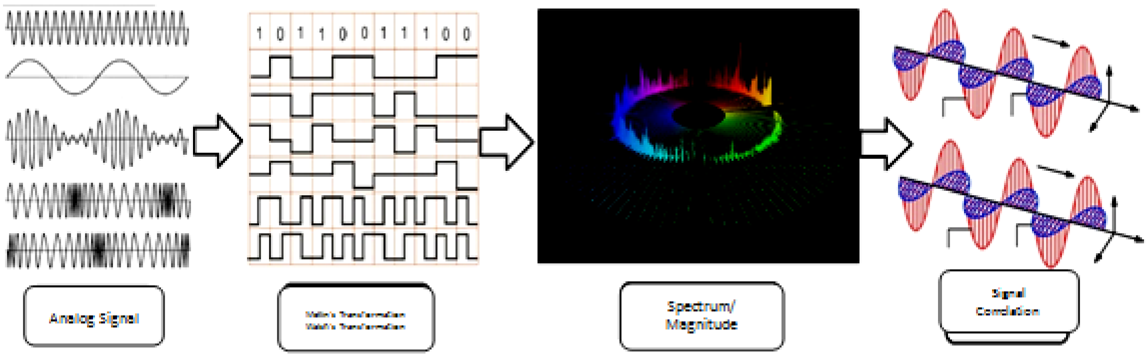


Figure 7. Schematic of the Qur'an memorization test system

As for the steps carried out after the Qur'an memorization test system, the system will first transform the analog signal in the time domain into a digital signal in the frequency domain. Analog signals are recorded and transformed using Mellin transform and Walsh transform. Next, the system will compute the magnitude/spectrum, and the results of this spectrum computation are used as a reference for proximity to various test signals.

The flow chart for the computational process of the Walsh Transform is built based on Figure 8:

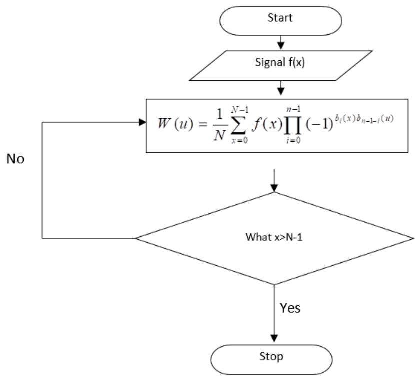


Figure 8. Walsh transformation flow chart.

The Walsh transform has the same function as the Mellin transform, but the Walsh transform performs computations non-sinusoidally.

4. Result and Discussion

The voice training samples used in this study amounted to 100 voice samples representing the characteristics of different sound vectors. The image below shows some sample sounds used for training. The training was carried out using the Mellin transformation algorithm and the Walsh transformation with probability constants of testing, = 0.3, 0.4, 0.5, and 0.6.

Figure 9. Some samples of the sound of memorizing the Qur'an used

Each sound has a vector pattern that is specific or different from one sound to another. In the learning process of sound samples using Mellin transform and Walsh transform, the reference sound pattern vector must be determined before testing. Figure 10 shows a vector of reference sound patterns resulting from observations on 100 sound samples.

9.99535699546017E-5	0.0001001692332836	0.0001	-0.293801633285709
2.50158992850141E-6	3.25947511418866E-6	4.34704512402303E-6	-0.30575604046837
-0.336753250103178	1.13849978120931	-0.187183333333333	-0.902076666367916
0.397296094717293	1.82732669404626	0.650629166666667	-1.83162869901254
0.779660415806851	1.86309238239341	0.994954166666667	-0.878621249584825
1.07501999071399	1.05970877113439	-0.0365583333333333	-0.723962589427401
0.631029457284358	0.862525635415623	-0.384370833333333	-0.870062052203987
0.472586927362773	0.131211151471697	-1.30815	0.238447587766701
-0.0171500980189847	-0.621262764987162	0.146829166666667	-0.00309206606951745
0.512961721007016	-0.210806151445337	2.28494583333333	-0.299640445173161
-0.365730112463888	-0.293801633285709	-1.89539583333333	1.02419877793535
-0.273650304374742	-0.30575604046837	-2.33271666666667	-0.839030678145709
-0.745511762278168	-0.902076666367916	-2.11122916666667	-0.663204677375988
-0.159925711927363	-1.83162869901254	-0.607191666666667	-0.293801633285709
-0.163108104622369	-0.878621249584825	-3.0485	-0.30575604046837
0.228055354931903	-0.723962589427401	-3.66249166666667	-0.902076666367916
-1.0024730447792	-0.870062052203987	-2.4955875	-1.83162869901254
-0.257606144242674	0.238447587766701	-0.207704166666667	-0.878621249584825
-0.650955685101114	-0.00309206606951745	1.0322375	-0.723962589427401
-0.360964584193149	-0.299640445173161	1.59048333333333	-0.870062052203987
0.103526104003302	1.02419877793535	-0.812220833333333	0.238447587766701
0.200013542096574	-0.839030678145709	-1.63849583333333	-0.00309206606951745
-0.412988805200165	-0.663204677375988	1.40758333333333	-0.299640445173161
0.0882976939744119	-1.0363060750004	0.410745833333333	1.02419877793535
-0.115752682624845	-1.61448288951334	0.5148375	-0.839030678145709
0.815266456871647	-0.398438941580249	-2.06375833333333	-0.663204677375988
-0.468324391250516	0.33322613468017	-0.870062052203987	-0.293801633285709
-0.427743241848948	0.591530954929117	0.238447587766701	-0.30575604046837
-0.661034874122988	0.640508437939888	-0.00309206606951745	-0.902076666367916
0.271618989888568	0.0724091755017688	-0.299640445173161	-1.83162869901254
-0.200242468014858	-0.283995592553736	1.02419877793535	-0.878621249584825
-0.260498349153941	-0.69619198751575	-0.839030678145709	-0.723962589427401
-0.0530721213371853	-0.224716494709483	-0.870062052203987	-0.870062052203987

Figure 10. Sound pattern vectors resulting from corrections and observations on a number of sound samples used as training.

The test of the Qur'an memorization system was carried out on four sample characteristics. The first characteristic is a sample containing information on signals having =0,3, the second characteristic is a sample containing information for signals having =0.4, the third characteristic is a sample containing information for signals having = 0.5, and the fourth characteristic is a sample containing information signals that have =0.6. Figure 10 shows some of the results of testing the Qur'an memorization testing system, and some examples of Al-Qur'an memorization test results which include a false positive rate are shown in Figure 10.

4.1. Mellin Transformation performance measurement

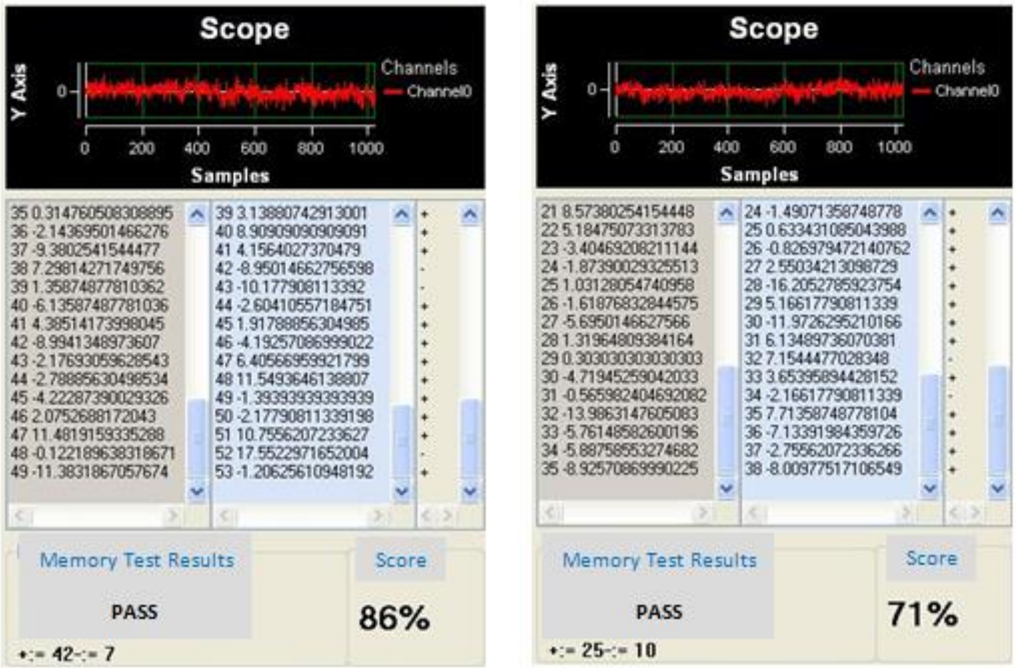


Figure 11. Some sound test results

Figure 12. Some false positive rate results

Measurement of system performance is carried out with gradual training. In samples containing information on signals that have =0.3 , the Qur'an memorization test system has an accuracy rate of 65%. Table 4.1 illustrates some of the results of measuring the performance of the sound testing system. The results of the system evaluation show that an increase in Detection Rate is closely related to an increase in the number of trainings. In samples containing information on signals that have =0.4 , the Qur'an memorization test system has an accuracy rate of 70%. Table 1 illustrates some of the results of measuring the performance of a sound testing system.

Table 1. The results of the Qur'an memorization test system performance.

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	40	0,6	0,4
50	100	49	0,51	0,49
75	100	55	0,35	0,55
100	100	65	0,25	0,65

Table 2. The results of the performance of the Qur'an memorization testing system

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	45	0,55	0,45
50	100	52	0,48	0,52
75	100	61	0,39	0,61
100	100	70	0,3	0,7

In samples containing information on signals that have =0.5 (k_3), the Qur'an memorization test system has an accuracy rate of 82%. Table 4.3 illustrates some of the results of measuring the performance of a sound testing system (k_3). In samples containing information on signals that have =0.6 (k_4), the Qur'an memorization test system has an accuracy rate of 90%. Table 4.4 illustrates some of the results of measuring the performance of the category sound test system.

Table 3. The results of the Qur'an memorization test system performance (k_3).

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	50	0,5	0,5
50	100	59	0,41	0,59
75	100	70	0,3	0,7
100	100	82	0,18	0,82

Table 4. The results of the Qur'an memorization test system performance (k_4).

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	60	0,4	0,6
50	100	67	0,33	0,67
75	100	85	0,15	0,85
100	100	90	0,1	0,9

The test results for (k_1), (k_2), (k_3) and (k_4) show that the detection rate is strongly influenced by the complexity of the sample. For the same number of training samples, the detection rate performance results obtained are $(k_1)<(k_2)<(k_3)<(k_4)$. Figure 13 shows a graph of the performance results of the Qur'an memorization testing system (k_1), (k_2), (k_3) and (k_4).

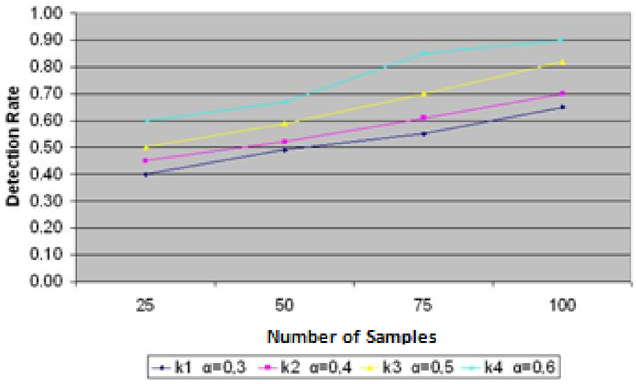


Figure 13. Mellin transformation performance graph on the Qur'an memorization test system (k_1), (k_2), (k_3), and (k_4).

In Figure 13, the graph illustrates the testing and measurement of performance carried out after 25 vectors of memorized Al-Qur'an sound patterns were trained for the overall characteristics of the sample. (k_1), (k_2), (k_3) and (k_4). The number of test samples is 100 vectors of memorized Al-Qur'an sound patterns, for all stages of training. In the early stages of testing, the system has been trained on 25 sound pattern vectors, and the detection rate values for . are obtained successively k_1 = 0,4 or 40%, k_2 = 0,45 or 45%, k_3 = 0,50 or 50% and k_4 = 0,6 or 60%. In the second stage, testing is carried out on a system that has been trained with 50 sound pattern vectors, and the detection rate values for . are obtained successively k_1 = 0,49 or 49%, k_2 = 0,52 or 52%, k_3 = 0,59 or 59% and k_4 = 0,67 or 67%. In the third stage, testing is carried out on a system that has been trained on 75 sound pattern vectors, and the detection rate values for . are obtained successively k_1 = 0,55 or 55%, k_2 = 0,61 or 61%, k_3 = 0,70 or 70% and k_4 = 0,85 or 85%. And in the final stage, the test is carried out on a system that has been trained with 100 sound pattern vectors, and the detection rate values for are obtained successively k_1 = 0,65 or 65%, k_2 = 0,70 or 70%, k_3 = 0,82 or 82% and k_4 = 0,90 or 90%.

4.2. Walsh Transformation performance measurement

Measurement of system performance is the same as testing the Mellin transformation, carried out with gradual training. In samples containing information signals having α=0,3 (k_1), the Qur'an memorization testing system has an accuracy rate of 65%. Table 4 illustrates some of the results of measuring the performance of the sound testing system (k_1). The results of the system evaluation show that an increase in Detection Rate is closely related to an increase in the number of trainings. In samples containing information signals having α=0,4 (k_2), the Qur'an memorization testing system has an accuracy rate of 75%. Table 4.6 illustrates some of the results of measuring the performance of the sound testing system (k_2).

Table 4. The results of the performance of the Qur'an memorization testing system (k_1).

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	41	0,59	0,41
50	100	49	0,51	0,49
75	100	57	0,33	0,57
100	100	65	0,25	0,65

Table 5. The results of the performance of the Qur'an memorization testing system (k_2).

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	50	0,5	0,5
50	100	52	0,48	0,52
75	100	61	0,39	0,61
100	100	75	0,25	0,75

In samples containing information signals having α=0,5 (k_3), the Qur'an memorization testing system has an accuracy rate of 85%. Table 6 illustrates some of the results of measuring the performance of a sound testing system (k_3). In samples containing information signals having α=0,6 (k_4), the Qur'an memorization testing system has an accuracy rate of 95%. Table 7 illustrates some of the results of measuring the performance of the category sound testing system (k_4).

Table 6. The results of the performance of the Qur'an memorization testing system (k_3).

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	50	0,5	0,5
50	100	60	0,4	0,6
75	100	80	0,2	0,8
100	100	85	0,15	0,85

Table 7. The results of the performance of the Qur'an memorization testing system (k_4).

Number of Training Samples	Number of Testing Samples	Correct Number of Detections	False Positive Rate	Detection Rate
25	100	69	0,31	0,69
50	100	73	0,27	0,73
75	100	85	0,15	0,85
100	100	95	0,05	0,95

Test results for (k_1), (k_2), (k_3), dan (k_4) shows that the detection rate is strongly influenced by the complexity of the sample. For the same number of training samples, the detection rate performance results obtained are $(k_1)<(k_2)<(k_3)<(k_4)$. Figure 4.5 shows a graph of the performance results of the Qur'an memorization testing system (k_1), (k_2), (k_3) and (k_4).

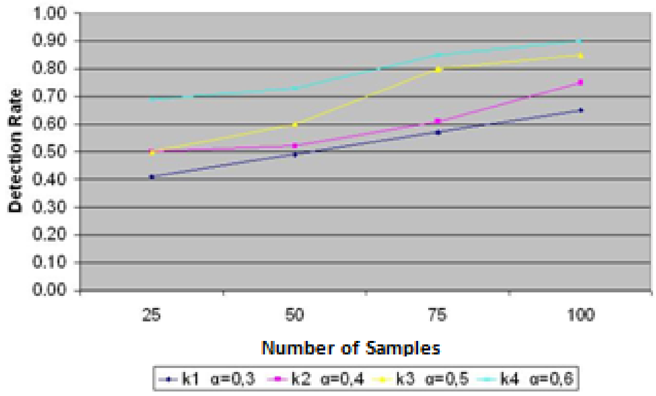


Figure 14 Performance graph of the Walsh transformation on the Qur'an memorization test system (k_1), (k_2), (k_3) and (k_4).

In Figure 14, the graph illustrates the testing and measurement of performance carried out after 25 vectors of memorized Al-Qur'an sound patterns were trained for the overall characteristics of the sample (k_1), (k_2), (k_3) and (k_4). The number of test samples is 100 vectors of memorized Al-Qur'an sound patterns, for all stages of training. In the early stages of testing, the system has been trained on 25 sound pattern vectors, and the detection rate values for . are obtained successively k_1 = 0,4 or 40%, k_2 = 0,50 or 50%, k_3 = 0,50 or 50% and k_4 = 0,69 or 69%. In the second stage, testing is carried out on a system that has been trained with 50 sound pattern vectors, and the detection rate values for are obtained successively k_1 = 0,49 or 49%, k_2 = 0,52 or 52%, k_3 = 0,60 or 60% and k_4 = 0,73 or 73%. In the third stage, testing is carried out on a system that has been trained on 75 sound pattern vectors, and the detection rate values for are obtained successively k_1 = 0,57 or 57%, k_2 = 0,61 or 61%, k_3 = 0,80 or 80% and k_4 = 0,85 or 85%. And in the final stage, the test is carried out on a system that has been trained with 100 sound pattern vectors, and the detection rate values for are obtained successively k_1 = 0,65 or 65%, k_2 = 0,75 or 75%, k_3 = 0,85 or 85% and k_4 = 0,90 or 90%.

Based on the results of research that has been carried out, the results of the detection rate system performance are strongly influenced by the amount of training, observations of reference pattern vectors for testing, the complexity of the information contained in the sound signal, and the success rate of the system in mapping the input sound pattern vectors into sound pattern vectors in the audio signal. frequency domain. The state of the sound in the sample in memorizing the Qur'an can be recognized by the system if the sound pattern vector in the frequency domain or the sample in the frequency domain really contains a reliable sound feature map. Figure 4.7 illustrates the state of sound samples in the frequency domain in the Qur'an memorization sample which contains various information that has been successfully recognized, and Figure 4.8 contains several examples of sound samples in the frequency domain in the sample in the Qur'an memorization test which contains sound information patterns that was not recognized.

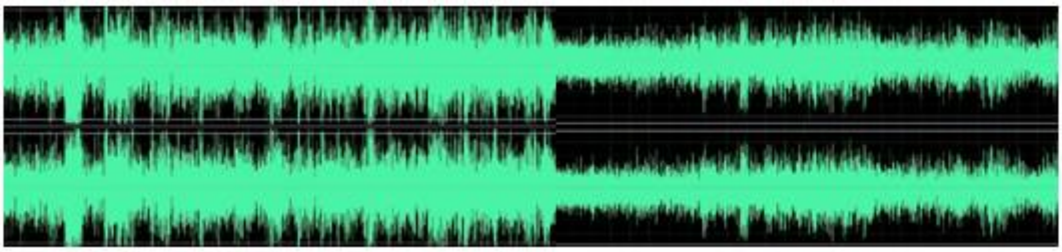


Figure 15.Some examples of samples in the frequency domain that contain sound information that has been recognized, in the image it can be seen that the entire sample contains information on the sound characteristics needed by the system to decide a feature in the sample contains a sound pattern.

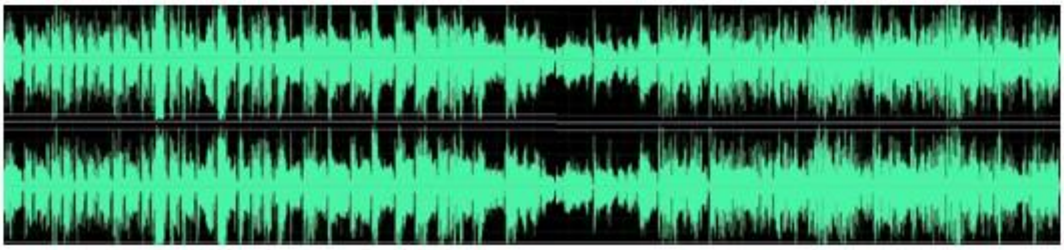


Figure 16.Some examples of samples in the frequency domain containing sound information that were not recognized successfully.

The role of the signal transformation process block in mapping the various features contained in the sound is very important. Usually, the signal transformation process block often fails to map sound characteristics when dealing with sound samples containing abnormal information, for example distorted information containing noise.

Computingly, the system is built with two main process blocks, namely: Mellin transformation and Walsh transformation, and based on the detection rate results achieved, the proposed system scheme has been able to perform testing and speech recognition using efficient computations, while the voice detection scheme that In general, and most of what has been done has always involved complex computations that are divided into several process blocks before the sound testing process is carried out.

5. Conclusion

The results showed that the Qur'an memorization test system using the Walsh transformation approach was able to recognize or have a detection rate of around 95% of sound patterns and Mellin's transformation had a detection rate of around 90%. The detection rate percentage shows that the two signal transformation models can be used as one approach for real-time sound testing systems. The advantage of the Walsh transformation and the Mellin transformation is the ability to recognize voice patterns with the amount of training data that is not too large, very appropriate to be applied to advanced systems that require a process of testing the memorization of the Qur'an.

The sound testing system using the Walsh transform and Mellin transformation is able to work well on samples that have standard feature information, on the contrary on samples containing distorted feature information, the sound testing system using either the Walsh transform approach or using the Mellin transformation has a high false positive rate, or have a big chance of error.

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