Scientific Journal Impact Factor (SJIF): 1.711

International Journal of Modern Trends in Engineering and Research

ISSN (ONLINE) : 2349 - 9745 ISSN (PRINT) : 2393 - 8161

Voice Recognition with Genetic Algorithms

Two Modules Crossover and Mutation

Hind Saleem Ibrahim Harba[1], Eman Saleem Ibrahem Harba [2]

[1] *Atmospheric Science, University of Mustansiriyah*

[2] *Media Unit and Informatics, University Of Baghdad*

Abstract— Speech recognition (or voice recognition) is a method of transform an acoustic signal to a text form, in which the voice recognition program work to identify the correct text word corresponding to each word of voice. Digital processing of voice signal is very important for automatic voice recognition technology that are widely used in security mechanism due to mimicry characteristic that is useful to use for many application field such as military, banking, and transaction over telephone network database access service, voice email, investigations, and management, electronic devices, control systems, like cell phones, or for to help peoples having disabilities (i.e. blinds, handicapped peoples, else) to control devices (such as operating a computer system, controlling a wheelchair, etc.). Genetic algorithms are useful for searching a space in multi-directional way from large spaces and poorly defined space. In this paper, the use of Genetic Algorithm (GA) for voice recognition is described. In order to extract valuable information from the voice signal, make decisions on the process, and obtain results, the data needs to be manipulated and analyzed. If the instant voice is not matched with same person's reference voices in the database, then Genetic Algorithm (GA) is applied between two randomly chosen reference voices. Again the instant voice is compared with the result of Genetic Algorithm (GA) which is used, including its three main steps: selection, crossover and mutation. We illustrate our approach with different sample of voices from human in our institution.

Keywords— Speech recognition, voice recognition, Genetic Algorithm

I. INTRODUCTION

Speech is one of the most important tools for communication between human and his environment, therefore manufacturing of Automatic System Recognition is desire for him all the time [1]. Speech signals are composed of a sequence of sound. These sound and the transitions between them serve as symbolic representation of information. The arrangement of these sounds (symbols) is governed by the rule of language. The study of these rules and their implications in human communication is the domain of linguistic. The study and classification of the sounds of speech is called phonetics. Speech can be represented in term of its message content or information. An alternative way of characterizing speech is in terms of the signal carrying the message information, i.e., the acoustic waveform [2]. Speech recognition systems are detached the voice signal into several classes to identify which utterances could be recognize. The main difficulties in voice recognition system to separate and identify these classes is how to determine when a speaker starts the utterance and finishes it [3]. The types of speech are isolated word, connected word, and continuous word .In this paper, the English isolated words are treated for recognition, which done by design a voice recognition system model that based on genetic algorithms.

II. RELATED WORK

The early work on speech recognition goes back to 50 years (system of recognition of digits). The introduction of numerical methods and computer technology has increased system capacity [4].

In1990 Smith et al. [5], has been developed the recognizer (a form of nearest neighbor classifier for speaker independent recognition of isolated words or phrases). An input word or phrase (the test token) is compared with a stored vocabulary (reference tokens) and is labeled as the closest matching vocabulary entry.

In 2006, Patricia M.et al [6], proposed an approach for intelligent pattern recognition to identify the speakers through analyzing signal of sound by used intelligent technique, like the neural network (ANN) and fuzzy system. At first, they described voice recognition based on used a monolithic NN. They have implemented tests with 20 different words (Spanish words), that records from three different speakers. Their achieved a very good recognition results by used a monolithic NN based recognition system, and get an excellent recognition results by used a modular NN based recognition system, with considered it can be achieving about 96% recognition rate when increasing the database of words over the 100 words.

In 2010, Marta W. and Jacek D. [7], has been proposed an approach of voice recognition system that hybrid the genetic algorithm with a classifier of K-nearest neighbor. He has been proposed a satisfactory construction of the model and determined the simulation parameters influence on the classification score. He has been determined the constructed method of performance, and from results it shown the overall system accuracy has been got 94.2% of correctly classified patterns in 26 seconds.

In 2012, Zahira B. and Ali B. [4], has been used Genetic Algorithm (GA) to solve involved nonlinear, discrete and constrained problems for DTW. The obtained results show the important contribution of the genetic algorithms in temporal alignment through the increasingly small factor of distortion.

In 2014, Hitesh G. and Deepinder S. [8], has been proposed an advanced algorithm for speech recognition using combination of FBCC and Genetic algorithm. They found genetic algorithm for optimization gives better result for speech recognition. They found that the level of accuracy using Hidden Markov model (HMM)was strongly influenced by the optimization of extraction process and modeling methods while on the other hand better results can be achieved with the help of Genetic algorithm. It is found that recognition accuracy for feature extraction with FBCC features in comparison with MFCC is better. This algorithm has been tested on samples of various users with and without adding noise and a high degree of accuracy is achieved during recognition

III. GENETIC ALGORITHMS

3.1 Introduction

The genetic algorithms is a biological concepts of genetic behavior to learning machine and optimize training that is consider as a powerful tool for solving the computational problem need searching. These problems are very common in predicting phenomena of real-world, machine modelling, machine learning and for optimization. The first one who described the genetic algorithms are John Holland which is in 1960s and were subsequently studied by Holland and co-workers at the University of Michigan in the 1960s and 1970s [9]. Pioneered by John Holland, they attempt to mimic natural selection by using a population of competing solutions which evolve over a series of generations.

3.2 Basic Concept of Genetic Algorithms

In genetic algorithms, a population is composed of a number of individuals that has a unique code called a chromosome. These individuals given a many levels of adaptation to environment. For each generation, the evolution will raise the better fit individuals through allowing them to transfer and reproduce their genetic code to the next generation. Consequently, a naturally selection of highly fit individuals have more chance compared with the poorly-fit individuals. Throughout the reproduction, the operator of crossover exchanges two chromosomes subparts, in the other hand the mutation works on modulation the value at randomly chosen locations in the genetic code. After the reproduction process, it has been created a new generation that replacing the "old" population. Because the reproduction higher probability for well-fit individuals, the evolution eliminates would be poorly-fit individuals over generations and tends towards saving the optimal individuals (highest fit individuals). In terms of genetic algorithms, an individual perform a potential solution to the problem. The *search space* are set of all possible individuals, which refers to the candidate solutions collection to a problem. Each one of individual is represented by a chromosome that can be either a matrix or as a vector (*e.g.*, a bit string), or even a tree structure (*cf.* genetic programming) [7].

Throughout the simulation, the most population is subjugate to simulated evolution. At first, it should evaluated the every individual *fitness* in the population. The Fitness is calculated by using a fitness function that depends on the problem under study. Criterion function value corresponds to the perceived success of the individual in solving the problem. Thus, the *selection* chooses a solutions with higher values of the fitness function giving them a greater probability of recombination. After a pool of individuals for reproduction is selected, *crossover* takes place. This operator randomly exchanges parts of chromosomes between the two parents. The next operator – *mutation* randomly flips some of the bits in the chromosome. Mutation and crossover occur with a certain probability. Finally, the old population is replaced by the newly obtained one [10].

3.3 Standard Genetic Algorithms

There are two types of algorithms:

3.3.1 Simple Genetic Algorithm (SGA)

This is the first proposed genetic algorithms that designed by Holland. It is commonly called simple genetic algorithm (SGA) or stander genetic algorithm, the procedure of simple genetic algorithm SGA can be describes in follows [11].

Input:	Initialization (population)
Output:	Extract the best individual

Step 1: Initialization (population).
Step 2: Evaluation (population);
Step 3: Generation ^ 0;
Step 4: While not stops criteria on do Selection (population, parent);
Step 5: Crossover (parent, offspring, pc);
Step 6: Mutation (offspring, pm);
Step 7: Evaluation (offspring);
Step 8: Population ^ offspring;
Step 9: Generation ^ generation+1;
Step 10: End while
Step 11: Extract the best individual
Step 12: End SGA;

Where population solution is used as all population would be generated in each generation based upon the previous generation. Holland has also put the rules (bases) related to this algorithm depending on this study futilely population.

3.3.2 Steady State Genetic Algorithm (SSGA)

It is an alternative of the genetic algorithm as the population would change gradually by generating few new individuals and replacing them in the population in each generation. This is similar to the development of elephants where a small part of the population is to be replaced by new offspring (children), the following procedure describes all steps of the SSGA [12].

Input:	Initialization (population)
Output:	Extract the best individual

Step 1: Initialization (population);
Step 2: Evaluation (population);
Step 3: Generation ^ 0;
Step 4: While not stops criteria on do Selection (population, parent);
Step 5: Crossover (parent, offspring, pc);
Step 6: Mutation (offspring, pm);
Step 7: Evaluation (offspring);
Step 8: Replacement(population, offspring);
Step 9: Generation ^ generation+1;
Step 10: End while
Step 11: Extract the best individual
Step 12: End SSGA;

IV. MODEL FOR A VOICE RECOGNITION SYSTEM

The voice recognition system is able to transcribe a human voice into digital information, understandable and recognizable by the computer.

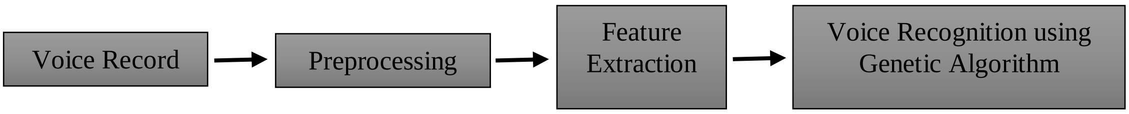

Figure 1: the experimentation procedure of voice recognition system

The voice signal is first record then digitized and modeled. The next step is extracted features from the relevant parameters for speech recognition. These parameters are sent to a recognition module to identify the present sounds in the signal.

4.1 Recoding of Sound

We have been used a microphone as a voice recorder to record voice in a closed room and save the voice using audio file format.wav. Here, we choose amplitude values to process. So the same sounds are varying due to this noise. In this case comparing amplitude values of sound would not give better solution. So we filtering the noise and then applying GA so that the good features are come.

4.4 Voice Recognition using Genetic Algorithm

The voice features are recognized using genetic algorithm following a systematic technique which includes repeated iterations consisting of genetic operators that are selection, crossover, mutation and reproduction until we get the optimal solution. The operation of a genetic algorithm is based on the following phases.

4.4.1 Organization of the GA (Selection, Crossover, Mutation, Replacement)

A. Fitness Function

A fitness function is a particular type of objective function that is used to summarize, as a single figure of merit, how close a given design solution is to achieving the set aims. In particular, in the fields of genetic programming and genetic algorithms, each design solution is commonly represented as a string of numbers (referred to as a chromosome). After each round of testing, or simulation, the idea is to delete the 'n' worst design solutions, and to breed 'n' new ones from the best design solutions. Each design solution, therefore, needs to be awarded a figure of merit, to indicate how close it came to meeting the overall specification, and this is generated by applying the fitness function to the test, or simulation, results obtained from that solution. The Fitness function used is calculated by two ways by used equation (1) and equation (2) [13]:

$$\text{Fitness}=\sum x \quad \ldots\ldots\ldots (1)$$

And

$$\text{Fitness}=\sum \frac{x}{n} \quad \ldots\ldots\ldots (2)$$

Where:

n: is the length vector of sound

Fitness: is the evaluation

Roulette Wheel Selection (RWS):

Roulette Wheel Selection (RWS) also known as “Fitness Proportionate Selection” is the most common method for implementing [14], assigns a probability of selection to each individual. Each individual is assigned a slice of circular" roulette wheel", the size of the slice begin proportional to the individual's fitness. The wheel is spun n times, where n is the number of individuals in the population. On each spin, the individual under the wheel's marker is selected to be in the pool of parents for the next generation. The probability of individual i being selected is :

$$P_i = \frac{f_i}{\sum_{j=1}^{n} f_j} \quad \ldots\ldots\ldots (3)$$

where n is the number of individuals in the population and *fi* is the fitness of individual *i*. Individuals are then selected stochastically based on their probability of selection, thus, a individual with high fitness will have higher chance of being selected while there is still a chance for the less fit individual to be selected. In this way diversity is maintained within the population. This method is as follows:

The Roulette Wheel Selection Algorithm

Step 1: Sum of the total expected value of individuals in the population.
Step 2: Call this sum T.
Step 3: Repeat N times.
Step 4: Choose a random integer R between 0 and T.
Step 5: Loop through the individuals in the population.
Step 6: Summing the expected values, until the sum is greater than or equal to R.

The individual whose expected value puts the sum over this limit is the one selected.

B. Two Point Crossover:

It must select two positions and only the bits between the two positions are swapped. This crossover method can preserve the first and last parts of a chromosome and just swap the middle part.

Parent 1	1	0	0	1	0	1
Parent 2	0	1	0	0	1	1

K = 2 k = 5

two point crossover

Offspring 1	1	0	0	0	1	1
Offspring 2	0	1	0	1	0	1

Figure 2: Example of Two Point Crossover.

C. Mutation for New Offspring:

We must select two positions randomly. Only the genes of the two positions are swapped.

D.
E.

Offspring 1	1	0	0	0	1	1
Offspring 2	0	1	0	1	0	1

New Offspring 1	1	1	0	1	1	1
New Offspring 2	0	0	0	0	0	1

Figure 3: Schematic representation of mutation in a chromosome.

F. Triple tournament replacement:

Three individuals are chosen at random from the population, the worst of three individuals are replaced by offspring resulting from crossover and mutation of the fittest individuals. The steps of replacement can be described as follows:

1. Compere If p1.fit <p2.fit and p1.fit<p3 .fit replace p1.fit with O1
2. Else If p2.fit <p1.fit and p2.fit<p3 .fit replace p2.fit with O1
3. Else If p3.fit <p1.fit and p3.fit<p2.fit replace p2.fit with O1

Where the P.fit is the parent with fitness function (population) and O is the best offspring (high fitness).

G. Stopping Criterion:

The most common stopping criterion for GA is to specify a maximum number of its generations.

H. Parameters:

There are two basic parameters of GA [15]:

1. **Crossover probability:** It is how often crossover will be performed; if there is no crossover, offspring are exact copies of parents. If there is a crossover, offspring are made from parts of both parent's chromosomes.
2. **Mutation probability:** It is how often parts of chromosome will be mutated; if there is no mutation, offspring are generated immediately after crossover (or directly copied) without any change. If mutation is performed, one or more parts of a chromosome are changed.

The number of generations and the mutation and crossover probabilities are the values which most be given to start the process of optimization. All these parameters have great influence on the GA performance. In this work use pc=0.9.pm=0.01.

4.5 Comparison between Two Sound Files

In our approach, we compare the genetic resultant sound with other sound in following two ways [16]:

a) Compare the Genetic Resultant Sound with Instant Sound using Threshold Value:
After getting a better offspring, we compare this offspring (sound file) with instant voice file using a threshold value for getting the optimal solution.

b) Compare the Genetic Resultant Sound with Instant Sound using Euclidean distance:
The Euclidean distance or Euclidean metric is the "ordinary" distance between two points that one would measure with a ruler, and is given by Pythagorean formula. The formula for this distance from the point X(x1, x2, x3, ….xi) to Y(y1, y2, y3, ...yi) is given by [16]:

$$d_{i=1} = \sum^{n} (xi - yi)^2 \text{ …….. (4)}$$

After getting a better offspring, we calculate the Euclidean distance between this offspring (sound) and input sound. Here, Euclidean distance is inversely proportional to the probability of voice matching.

In this work, we select a threshold value 1.2 after a lot of tests. If the difference is below the threshold value (the log10 with absolute with difference), then counter is increased, otherwise loop. If the counter is greater than from the half of the file size; then we can say that the two voices are same. If two files are not same كمليها

V. SIMULATION AND RESULTS

Simulation was taken out in Matlab and in order to simulate the analytics discussed previously, the database of same person voice is taken. This database contains 25 voices of same one word "zero" of same person, we has been calculated Euclidean distance and the percentage of similarity using threshold value.

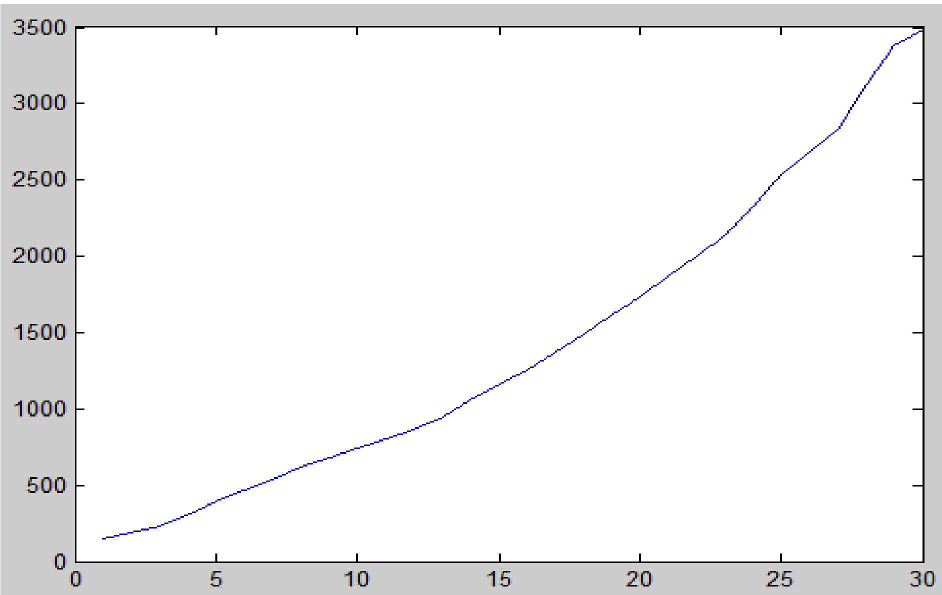

Figure 4: input voice of the word zero

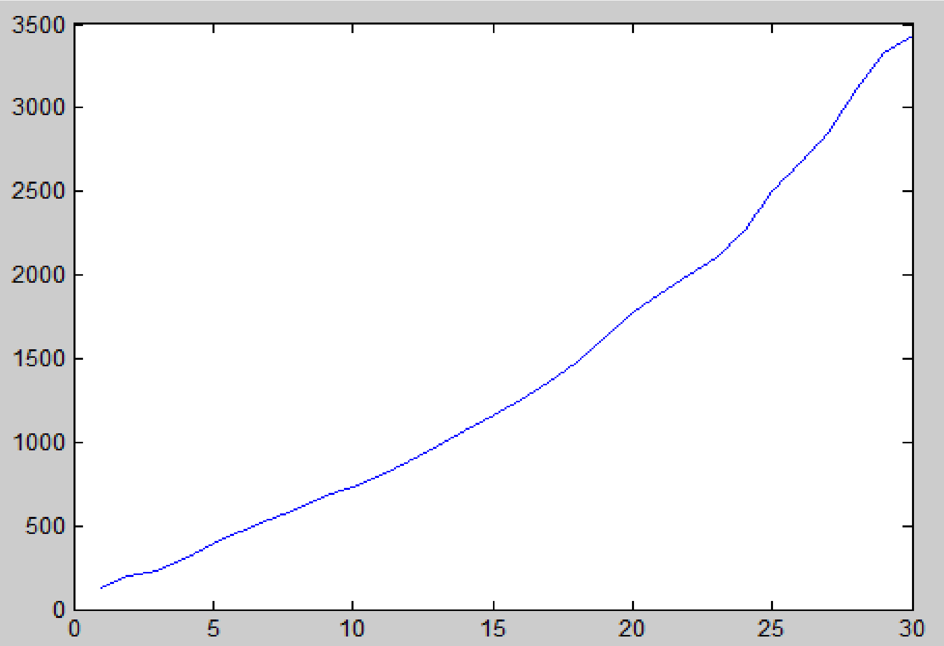

Figure (5): Reference voice of word zero (Second voice found in database (sound number 8))

We apply Genetic Algorithm that generate a new voice with some new characteristic that makes the closest match to input voice. As shown in figure 6.

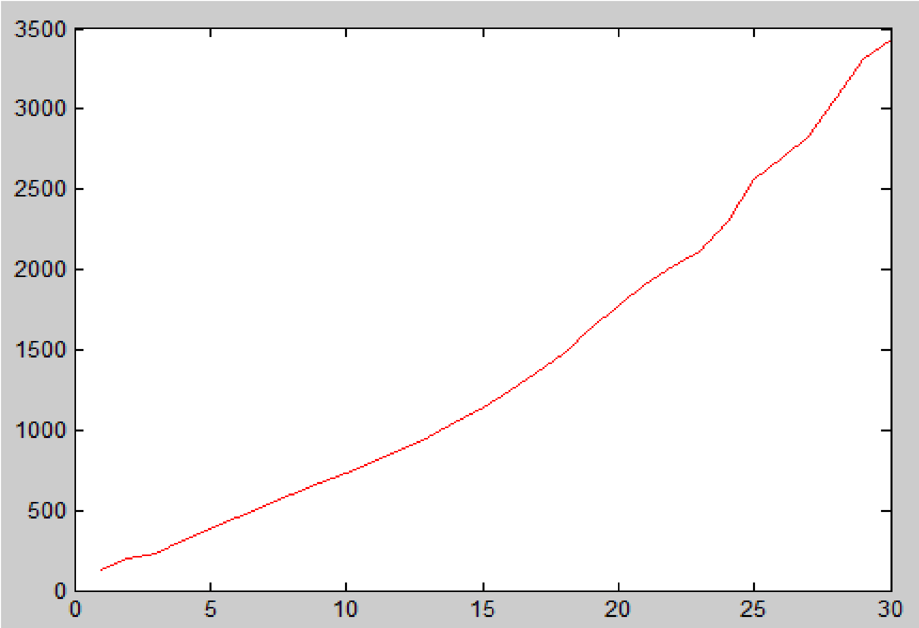

Figure (6): The best voice from genetic (offspring)

This voice has been generated after use of functions fitness of the various possibilities and the best individual as shown in table (1).

International Journal of Modern Trends in Engineering and Research (IJMTER)
Volume 02, Issue 12, [December – 2015] **ISSN (Online):2349–9745 ; ISSN (Print):2393-8161**

Table (1): functions fitness used for the various possibilities and the best individual

Best Ind	Gen	Cross	Mut	threshold	Euclidean	fitness	Fitness uses
6	3	0.9	0.1	23	109.666310457224	42980.6132633003	$\sum x$
23	5	0.9	0.1	19	118.520037414591	43030.3579495963	
7	3	0.8	0.1	20	114.564297764059	43016.8811480553	
19	5	0.8	0.1	19	115.031120683858	43003.3218300321	
13	3	0.9	0.01	13	107.363036199449	43004.7416730065	
20	5	0.9	0.01	20	114.784484074428	42997.2634787778	
16	5	0.8	0.01	23	103.906254316068	42007.4382262417	
24	3	0.8	0.01	22	116.564007764059	43554.7416730065	
							$\frac{\sum x}{n}$
9	3	0.9	0.1	19	114.564297764059	1433.89603826851	
21	5	0.9	0.1	19	115.031120683858	1433.44406100107	
11	3	0.8	0.1	24	105.750551663244	1432.92241386490	
19	5	0.8	0.1	19	116.322253723615	1432.99832003888	
17	3	0.9	0.01	18	111.684281055650	1432.41027569156	
21	5	0.9	0.01	22	114.684281055650	1434.41027569156	
14	5	0.8	0.01	16	106.344650508679	1432.99896403484	
11	3	0.8	0.01	19	105.333650508679	1432.88896403484	

The results of two modules (crossover and Mutation) for set of voice in four stage has been explained in table 2.

Table (2): mating process between the each two stages of four stages

Two Voice(2+4)		Voice result (1)	
123.724135438891	127.054910198876	123.724135438891	127.054910198876
195.054642093894	190.487478341142	195.054642093894	190.487478341142
234.084830671206	238.447060952045	238.447060952045	234.084830671206
304.828386221429	309.290698717918	309.290698717918	304.828386221429
380.630408481474	376.609147170217	376.609147170217	380.630408481474
460.883797370109	454.178176330958	454.178176330958	460.883797370109
533.415071035990	527.424817749119	533.415071035990	527.424817749119
614.548634893759	613.636162640871	614.548634893759	613.636162640871

Voice Result (1)		Voice Result (2)	
123.724135438891	127.054910198876	123.724135438891	127.054910198876
195.054642093894	190.487478341142	190.487478341142	195.054642093894
238.447060952045	234.084830671206	238.447060952045	234.084830671206
309.290698717918	304.828386221429	309.290698717918	304.828386221429
376.609147170217	380.630408481474	376.609147170217	380.630408481474
454.178176330958	460.883797370109	454.178176330958	460.883797370109
533.415071035990	527.424817749119	527.424817749119	533.415071035990
614.548634893759	613.636162640871	614.548634893759	613.636162640871

Voice Result (2)		**Voice Result (3)**	
123.724135438891	127.054910198876	123.724135438891	127.054910198876
190.487478341142	195.054642093894	195.054642093894	190.487478341142
238.447060952045	234.084830671206	234.084830671206	238.447060952045
309.290698717918	304.828386221429	304.828386221429	309.290698717918
376.609147170217	380.630408481474	380.630408481474	376.609147170217
454.178176330958	460.883797370109	460.883797370109	454.178176330958
527.424817749119	533.415071035990	533.415071035990	527.424817749119
614.548634893759	613.636162640871	614.548634893759	613.636162640871
Voice Result (3)		**Voice Result (4)**	
123.724135438891	127.054910198876	127.054910198876	123.724135438891
195.054642093894	190.487478341142	195.054642093894	190.487478341142
234.084830671206	238.447060952045	234.084830671206	238.447060952045
304.828386221429	309.290698717918	304.828386221429	309.290698717918
380.630408481474	376.609147170217	380.630408481474	376.609147170217
460.883797370109	454.178176330958	460.883797370109	454.178176330958
533.415071035990	527.424817749119	527.424817749119	533.415071035990
614.548634893759	613.636162640871	614.548634893759	613.636162640871

By compere input voice with genetic result (the best one). It's appeared that the two voices are mostly same. As shown in figure (7).

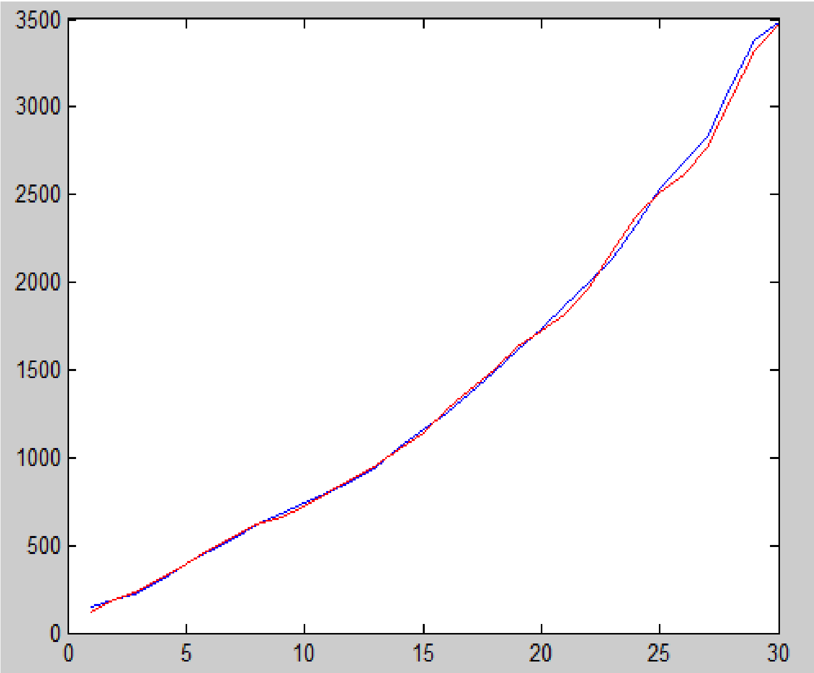

Figure (7): compare input voice with genetic result (the best one).

From results, it's appeared that when the crossover probability is 0.8 for and the mutation probability is 0.1 with a maximum number of iteration value of 3, we has been got a best probability to choose the best child (i.e. 6 or 10).

Through our test for probability of similarity and recognition of 25 voice (include input voice), it appeared that the method get nearly 100% in matching or similarity, as shown in figure (8).

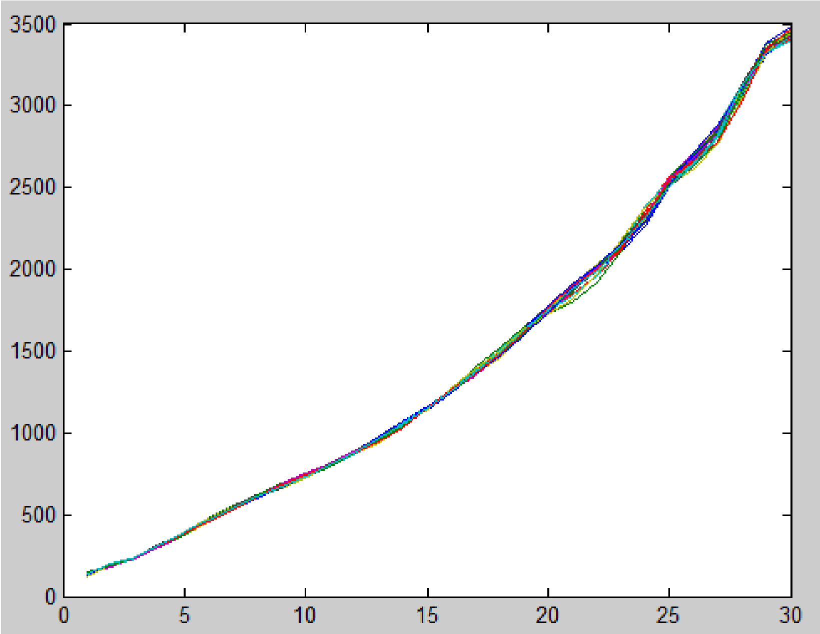

Figure (8): compare input voice with genetic result (child) by using threshold

VI. CONCLUSION

The emphasis of this paper is to describe and develop voice recognition system based on the genetic algorithm to determine the performance of the constructed method. Having determined the influence of the simulation parameters on the classification score, a satisfactory construction of the model was proposed, providing the overall nearly 100% correctly classified patterns for test of 25 voices for same word of same person. We still need to doing more tests with different voices of persons with many words, beside includes a levels of noise within it.

REFERENCES

[1] Meysam M. P., Fardad F., "An Advanced Method for Speech Recognition", International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering Vol. 3, No.1, 2009.

[2] Dr. Jane J. S., Rasha H. A., "Speech Recognition Using Genetic Algorithm", International Journal of Computer Engineering and Technology (IJCET), ISSN 0976-6367(Print),, ISSN 0976 - 6375(Online), Vol. 5, Issue 5, May (2014), pp. 76-81.

[3] Bhupinder S., Rupinder K., Nidhi D., and Ramandeep K., "The process of Feature Extraction in Automatic Speech Recognition System for Computer Machine Interaction with Humans: A Review", International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE), Volume 2, Issue 2, ISSN: 2277 128X, February 2012.

[4] Zahira B. and Ali B., "Genetic Algorithms in Speech Recognition Systems", International Conference on Industrial Engineering and Operations Management Istanbul, Turkey, July 2012.

[5] Smith L.A., Scott B.L., Lin L.S. and Newell J.M., "Template adaptation in a hypersphere word classifier", Proc. IEEE Int. Conf. Acoustic, Speech, and Signal Processing, ISSN: 1520-6149, April 1990.

[6] Patricia M., Jerica U., Daniel S., Miguel S., Miguel L., and Oscar C., "Voice Recognition with Neural Networks,Type-2 Fuzzy Logic and Genetic Algorithms", Engineering Letters, 13:2, EL_13_2_9 (Advance online publication: 4 August 2006).

[7] Marta W., and Jacek D., "Voice Command Recognition Using Hybrid Genetic Algorithm", Faculty of Technical Physics and Applied Mathematics, Gdansk University of Technology, 2010.

[8] Hitesh G., and Deepinder Singh W., "Speech Feature Extraction and Recognition Using Genetic Algorithm", International Journal of Emerging Technology and Advanced Engineering (IJETAE), Vol. 4, Issue: 1, ISSN 2250-2459, January 2014, pp. 363-369.

[9] Holland J., "Adaptation in Natural and Artificial Systems", Ann Arbor, MI: The University of Michigan Press, 1975.
[10] Mitchell Melanie, "An Introduction to Genetic Algorithms", A Bradford Book, MIT Press, ISBN 0–262–13316–4, Fifth printing, 1998.
[11] Jeroen E., "Genetic Programming", Division of Image Processing, Department of Radiology C2S, Leiden University Medical Center.
[12] Goldberg D. E., "Genetic Algorithm in search, optimization, and Machine learning", Addison-Wesle, 1989.

