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Biometric Information Based on Distribution of Arabic Letters According to Their Outlet

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Abstract: In this research, the correlation and homogeneity properties of the presence matrix of the speech signal for the Arabic letters were tested and evaluate the possibility of distinguishing between them was achieved by extracting characteristic properties. The speech signal of the letters (acquired through the Recorder) with a binary matrix for its configuration and calculations of two properties of presence matrix, correlation, homogeneity studied. The values of these properties and the extent of their variation from one person to another and how close they are within the same group represent the exits which they belong.
The results in this paper illustrate the correlation and homogeneity properties of the Arabic letters to persons in alphabetical order provide a distinctive description for the person. The important of Arabic language or any other language how they affected by an significant factors as the economic situation of their users and civilization, as well as their scientific future.
This study is a good and authentic attempt in terms of using two types of relationships (correlation and homogeneity properties) , whose results will lead to important conclusions in the field of extracting the properties of sound and its difference from one person to another, depending on the outlets of speech.
The results of the practical application for the proposed algorithm show that correlation gave distinct results for the adoption of characters as a characteristic of the voice of the speaker, whereas homogeneity was a weak indicator that varied greatly for the same character with the same person.

Keywords: Speech Signal Recognition, Spoken Arabic Character Recognition, Digital Signal Recognition, Presence Matrix.

1. INTRODUCTION

Since the advent of the computer in the late 1940s, its connection to the language has stopped and is becoming more consolidated in both directions. The fact that language is the embodiment of what is in the human mind of activity, and the direction of the computer to simulate human functions and mental abilities imposed this continuous encounter, with unparalleled scientific and technical interaction.
This led to the Trinity: "Language - Computer - Application". The language of automatic processing has been developed by entering the fields of mathematical and statistical analysis. The computer has been configured to meet with language at high speed, large memory, small size, and high-end programming languages. The application has paved the way to the fields of education, humanities and acoustics.

The importance of the Arabic language in computerization is no longer a matter of well-being or secondary, but it is very important and depends on the future of the language, the status of their people, their current civilization, economic activity and scientific future. It is regrettable that Arabic language is one of the oldest human languages studied. At recent time. At recent time, very little studies have deal in the field of acoustics technology.

The linguistic studies of the modern era have undergone a remarkable development, with the emergence of modern linguistics founded by de Saussure, which revisited many of the concepts that prevailed the researches of language. These changes included the theoretical foundations on which this study was based, it has become increasingly sought for specialization and accuracy, because language is often taught at four levels, namely the vocal, epileptic, grammatical and semantic level [1] [2].

The vocal aspect of the language is one of the most important and fundamental aspects of the linguistic study, as it embodies the true concept of the voices, as Ibn Jinni defined it: "The voices makes all people express their purposes in good way" [3]. This is supported by de

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Saussure's opinion, which called for the simultaneous study of language and its operative form.

According to previous studies, the vocal aspect of the language has been studied, examined and analyzed, so the results leads to several sections, each of which deals with a particular aspect of the study. Acoustics has many applications in our lives. In addition to the great technical development in the recent time and the need to use the spoken language in communication between human from one side and human administrate machine on the other side, the applied acoustics are expanding and are expected to see greater expansion in the next years. This expansion develops the transmission, storage of sound waves, control of machines and devices [4].

Today, Computer applications have become comprehensive for all of us in the scientific and practical lives, and our various applications have become a major factor in facilitating the daily tasks and functions of man. This has included all the joints of life. It also extends to the various functions of the body, including pronunciation and speech, which is the subject of our current research [5].

2) RESEARCH OBJECTIVE

The related studies for the vast number of Arabic languages indicated the major side of these researches deals about the grammatical, morphological and semantic aspects, while the minor interest about vocal side of the language. Therefor there is a need for further studies and researches as many of its issues are still unknown, and needed to interpret and analyze the adoption of modern methods to find common denominators between modern technology. Electronic devices like computers and its software have main characteristics for analyzing and developing the acoustics science to serve this important aspect in the language understanding processes.

3) PREVIOUS STUDIES

There is no doubt that many previous studies have dealt with the subject of the treatment of sounds technically to find characteristics of the signal of speech, and these studies are found to Ibrahim Anis in (linguistic voices), Dr. Kamal Bishr in (Studies in linguistics [6]:

Section II: votes), Dr. Nabil Ali (Arabic and Computer), Dr. Abdul - Thiab Al- Ajili (Computer and Arabic Language), and Dr. Nihad Al-Mousa in Arabic (Towards a New Characterization in the Light of Computational Linguistics). Which drew attention to the use of computer technology, and employment Search Language Service [7]. In spite of all the above efforts, the Arabic language still lacks much research in the field of acoustics to provide the necessary data for computer experts to do their work in this field, and the work is expected to do more efforts, not at the level of individuals, but at the level of the integrated research team [8].

4) BRANCHES OF PHONOLOGY

The science that studies the sounds of language using material aspect is not considered as "the science that studies, analyzes and classifies the movement of sounds spoken in a language, including pronunciation, transmission and cognition" [6]. It deals with the study and analysis of spoken voices that are produced by the person voluntarily and selectively for the purpose of reporting, by analyzing them into their smallest parts (simple sounds or letters) and then acting as a classifier in accordance with certain criteria and studying their transition to ear of the hearer, and this transition is accompanied by physical and mechanical phenomena [7][8].

It is too difficult to study a language or dialect as a scientific search, without concentrate on the description of their sounds, sound systems, first speak and foremost a series of sounds, it must start the sound description for small pieces or small items [9].

5) SOUND PROPERTIES

There is a widespread tendency to associate certain properties of sound with those of characteristics
:

5.1 Pitch or Frequency

The sound layer refers to its height or down. Each individual sample has a specific range of sound layer that proportional as to his or her age and physical composition. The level of the individual's sound layer is determined based on three factors [9][10]:

- Length and thickness of vocal cords.
- degree of tension (sharpness).
- The volume of air outside the opening of the pylorus.

5.2- Loudness

The sound level indicates the intensity in which it appears and affected by a number of factors including:

- The amount and rate of airflow exhaled.
- Tension of vocal cords.
- The distance between the speaker and the sage.
- The reflections which happens because of the size and shape of the place [5][11].

5.3- Quality

The quality of the sound refers to those characteristics that give the voice of each individual its special character.

- Breathiness.
- Hoarseness.
- Harshness.
- Nasality.

The human letters are described by a set of characteristics such as a deep, turbulent, which can be

represented as one bit. The current idea is to limit these properties in a way that describes the humanized spoken letters and character representation through this set of properties [12].

6. VOICE RECORD

With the prevalence of modern electronic recording systems, speech will be limited to them. There are three criteria to be followed when recording [12] [13]:

A. sampling rate

Represent the number of times per second the digits sound are signified. Increasing for the number of times presentation proportion with the purity of the sound. In the case of speech, the appropriate representation is 22,050 hertz, and more is unnecessary and does not raise the quality. Quality up to 8,000 Hertz (this representation is used in telephone), the sound starts to be affected so much less so that it is difficult to understand speech [11][12].

B. Bit Depth

Defined as the monotony of the sound frame to maintain the variance of the sound wave intensity, which is either (8) in (48 dB) used in telephone systems, 16 - 24 bit less than 144 dB), and (32 bit) for values less than (192 dB). The accepted average value for most research that deals with sound equal to (16 bit) [6].

C. Format

Represent the save operation for the current audio files in the form of different digital formats such as: mp3, pcm, wav, and the formula that keeps the sound wave closer to reality is the last. The other formats compress the audio file for smaller space in the recorder or computer memory. It is important to record the original sound in wav format and may be saved in other formats. The original remains important for reference, especially if the sound waves are studied, analyzed or converted to other formats to be as data base for future processes [12].

7.PRE-PROCESSING OF THE ACOUSTIC SIGNAL

In order to deal with speech through the computer, sound must be converted to binary numbers by converting the electrical signal to binary system. The analog signal at moments separated by equal length called interval time for constant frequency named sampling process. Sound is a vibratory motion propagated by the molecules of matter, and characterizes the signal generated by the oscillation motion to amplitude and frequency. Initial processing of the acoustic signal is done and the coefficients of this signal are adopted in the temporal and temporal fields for analysis and differentiation [9].

There are several factors that affect to the interference of the sound signal when recording the character, including the surrounding medium. The high frequencies within the computer microphone and sound card furthermore the great difference of sound signal for each character and others. In this step, the noise is filtered by following several processes. The noise of the surrounding medium is recorded without the presence of an audio signal, the calculation of the displacement rate, the amplitude rate and the zero-crossing rate. All the Arabic letters are recorded separately, it cuts the character into fixed-size frames, calculates the amplitude and zero crossing ratios for each frame. Finally, the resulting values should be compared in the calculation of these amplitude and zero crossing values for all frames. If the values are close, keeping frames with amplitudes and zero crossings step greater than amplitude and zero crossing noise [1][10].

In order to distinguish the Arabic voices automatically, the sound signals of these voices are studied and processed in different fields to extract their features.

8. CO-OCCURRANCE MATRICES

The matrix was proposed by Haralick in 1973, a two-dimensional matrix (based on gray levels), which is mainly used in texture analysis because of its high ability to determine the spatial correlation of grayscale values in the image [2][13]. As a cumulative collector and each cell (p [I, j]) represents a number of pairs of mass dots that have density (i) and (j). Each pair of the mole is defined by the dimension and direction that can be represented by the displacement vector (d =), Where dx represents the displacement of the datum point from the x-axis and (dy) represents the displacement of the datum point from the y axis, as explained in figure (1) [14].

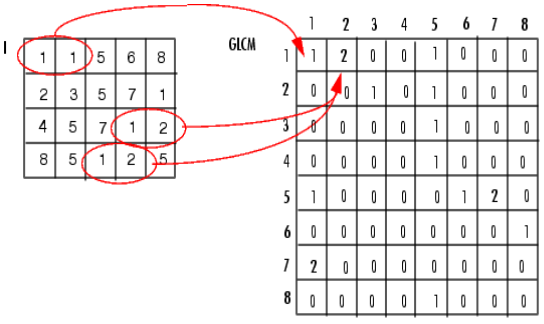

Figure 1. An example for the co-occurrence matrices.

In order to determine the spatial domain which depends to the space level values, a number of texture properties were calculated [6] [15].

to determine this spatial dependence of grayscale values, different structure characteristics are calculated, including a large number of attributes (energy, correlation,

contrast, homogeneity, …. etc.). In this research, we focus on the homogeneity and correlation properties, and these two properties are described as follows:

1- Homogeneity Function

The homogeneity value for the image affected by the equality of the grayscale levels for each pair of points, and the following equation shows how to calculate homogeneity [1][15]:

$$\text{Homogeneity} = \sum^{m} \sum^{n} \frac{p[i,j]}{1-|i-j|} \quad (1)$$

Where:

P: co-occurrence matrix value

n, m: dimensions of the co-occurrence matrix

2. Correlation Function

Represents the value of the Correlation between two points of image in each pair, and its value increased as the gray levels in the pair of dots are convergent. The correlation value is calculated by the following equation [2][13]:

$$\text{Correlation} = \sum^{m} \sum^{n} \frac{i-\mu(j-\mu)p[i,j]}{\delta} \quad (2)$$

Where:

μ represent average value.

P: co-occurrence matrix value

n, m: dimensions of the co-occurrence matrix

9. PROPOSED ALGORITHM

The algorithm below suggested the possibility of finding the characteristics of each spoken letter and indicating the minutes of the differences between them and their interpretation. Twenty-eight Arabic letters were recorded for 25 females and nine persons of different specifications were selected for each test. Each character is stored in a single sample with a sampling rate of (10000 Hz), bit depth (16 bit), format (wav), and then applied the following algorithm:

1. Read the sound file and configured.
2. Convert the sound file to a two-dimensional square matrix
3. Find the co-occurrence matrix for speech signal.
4.Extracting the two properties (correlation, homogeneity) of the co-occurrence matrix.
5. Apply the quad tree on the binary matrix, divide it into four parts, then perform step (3,4).

10. RESULTS DISCUSSION.

The analysis of the results explained the relationship between the correlation and homogeneity of a speaker's voice by pronouncing all the Arabic letters. Appendix I illustrate the correlation and homogeneity of the Arabic spoken by persons showed that despite the large convergence of exits totals of characters. The relations are obvious due to qualities from one person to another, which can be adopted as a characteristic of people.

In Appendix II, the strength of the descending sequence of each character for the Arabic characters spoken by the persons are shown (for which the test was performed). The sequence of characters can be approved as a characteristic of the speakers, the two attributes used in the character sequence are the region for those attributes of the presence matrix of the speech signal.

The results in table (1), shown in appendix III, illustrate the correlation and homogeneity properties of the Arabic letters to persons in alphabetical order provide a distinctive description for the person. Appendix III describe an accurate appearance of a clear discrepancy between the speakers when the same character is pronounced, which is strongly supports the results obtained in Appendix I.

Appendix IV evolve the values of the two characteristics at each quarter of the quadratic division, which assigns the idea of adopting the tree division to obtain the general average of the approved characteristics of the co-occurrence matrix. One of the matrix quarters have been distributed regularly within the rest of other quarters, where it is noted that the overall rate of the matrix is close to the total average rate of quarters for the co-occurrence matrix.

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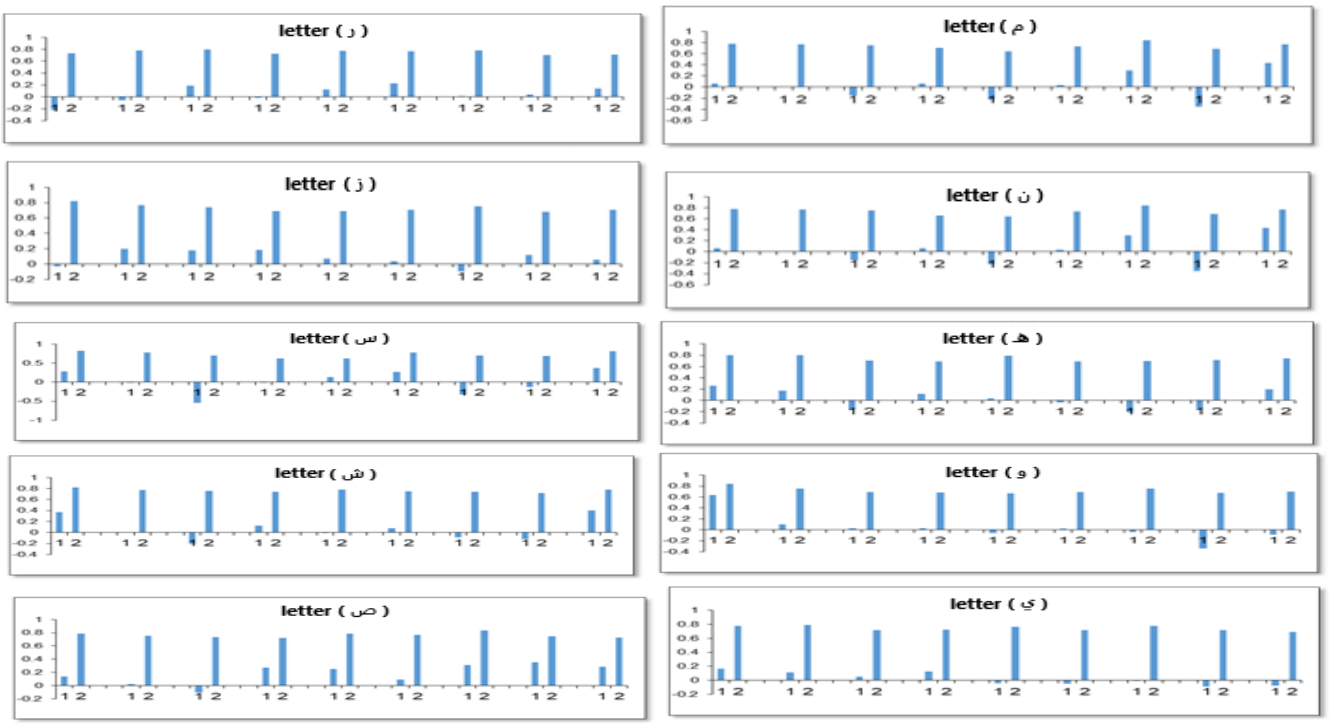
THE HOMOGENEITY AND CORRELATION PROPERTIES OF THE SPOKEN ARABIC CHARACTERS FOR NINE PERSONS

properties / letters	homog.	correl.	homog.	correl.	homog.	correl.	homog.	correl.	homog.	correl.	homog.	correl.	homog.	correl.	homog.	correl.	homog.	correl.
أ	0.045	0.79	0.143	0.825	0.076	0.805	0.048	0.748	0.145	0.786	-0.022	0.703	0.217	0.834	-0.158	0.795	0.26	0.818
ب	0.48	0.768	-0.164	0.788	0.331	0.796	-0.014	0.749	0.207	0.812	-0.137	0.669	0.068	0.773	0.29	0.748	0.085	0.737
ت	-0.086	0.749	0.01	0.771	0.08	0.77	0.017	0.745	0.074	0.779	0.092	0.705	0.245	0.839	-0.114	0.713	0.072	0.729
ث	0.438	0.82	0.188	0.776	0.037	0.767	-0.052	0.735	-0.064	0.777	-0.307	0.702	0.284	0.829	0.264	0.748	0.123	0.752
ج	-0.037	0.765	0.024	0.788	0.086	0.786	0.109	0.751	0.355	0.852	0.096	0.711	-0.067	0.764	-0.007	0.788	-0.038	0.765
ح	-0.025	0.786	0.125	0.795	0.011	0.755	0.037	0.715	-0.155	0.745	0.257	0.713	0.164	0.825	-0.245	0.687	0.015	0.76
خ	0.162	0.736	0.073	0.772	0.041	0.738	0.027	0.732	0.096	0.773	-0.035	0.669	0.288	0.825	0.214	0.708	0.185	0.775
د	0.158	0.764	0.18	0.786	0.222	0.75	0.019	0.699	-0.023	0.762	0.192	0.716	0.225	0.806	0.284	0.713	0.53	0.744
ذ	-0.012	0.753	0.132	0.75	0.077	0.774	0.089	0.731	0.311	0.784	0.129	0.719	0.061	0.76	0.444	0.688	0.141	0.702
ر	-0.22	0.733	-0.054	0.778	0.189	0.797	-0.016	0.725	0.124	0.775	0.225	0.768	0.015	0.783	0.039	0.7	0.144	0.708
ز	-0.026	0.818	0.198	0.77	0.18	0.743	0.184	0.748	0.071	0.819	0.036	0.71	-0.095	0.754	0.117	0.68	0.058	0.71
س	0.276	0.828	-0.002	0.781	-0.548	0.702	-0.018	0.719	0.133	0.787	0.272	0.775	-0.334	0.697	-0.122	0.691	0.373	0.81
ش	0.372	0.82	0.003	0.773	-0.205	0.759	0.122	0.745	-0.004	0.779	0.081	0.748	-0.091	0.742	-0.12	0.721	0.404	0.784
ص	0.14	0.786	0.027	0.756	-0.101	0.733	0.27	0.722	0.25	0.789	0.092	0.767	0.311	0.836	0.353	0.745	0.282	0.726
ض	0.53	0.874	0.017	0.759	-0.033	0.76	-0.243	0.632	0.17	0.785	0.048	0.681	0.187	0.823	0.026	0.688	0.106	0.686
ط	0.348	0.838	0.053	0.774	0.025	0.704	0.066	0.729	-0.111	0.763	0.131	0.714	0.21	0.822	0.012	0.707	-0.014	0.694
ظ	0.447	0.857	-0.042	0.754	0.147	0.735	-0.036	0.695	-0.263	0.778	0.079	0.675	0.253	0.794	0.169	0.72	0.047	0.684
ع	0.488	0.867	0.061	0.782	-0.2	0.712	0.037	0.727	0.007	0.735	-0.122	0.659	-0.558	0.596	-0.146	0.665	0.119	0.745
غ	0.586	0.878	0.094	0.763	0.145	0.737	0.078	0.704	-0.024	0.726	-0.039	0.719	0.082	0.742	-0.263	0.67	0.077	0.718
ف	0.302	0.79	0.075	0.773	0.121	0.804	0.101	0.731	0.214	0.797	-0.182	0.706	-0.014	0.777	-0.087	0.681	0.141	0.739
ق	-0.147	0.745	-0.099	0.756	0.043	0.73	3E-04	0.727	-0.089	0.786	-0.246	0.725	-0.131	0.654	-0.083	0.72	0.168	0.706
ك	0.032	0.793	0.007	0.764	8E-04	0.744	-0.158	0.725	0.259	0.769	0.159	0.705	0.157	0.804	-0.234	0.691	0.163	0.737
ل	0.159	0.804	0.178	0.794	-0.064	0.779	-0.049	0.718	-0.105	0.697	-0.124	0.685	-0.074	0.753	-0.04	0.661	0.089	0.757
م	0.264	0.804	0.189	0.821	-0.055	0.756	0.03	0.761	-0.122	0.726	0.089	0.76	0.297	0.84	0.01	0.693	0.364	0.79
ن	0.062	0.776	0.003	0.764	-0.154	0.753	0.059	0.769	-0.225	0.643	0.034	0.728	0.294	0.837	-0.348	0.687	0.433	0.772
ه	0.26	0.799	0.172	0.799	-0.161	0.707	0.121	0.692	0.038	0.791	-0.032	0.687	-0.207	0.697	-0.153	0.714	0.2	0.749
و	0.639	0.84	0.102	0.755	0.027	0.691	0.026	0.712	-0.057	0.665	0.026	0.686	-0.043	0.75	-0.341	0.673	-0.086	0.7

ي	0.167	0.78	0.109	0.794	0.054	0.716	0.126	0.725	-0.041	0.766	-0.053	0.72	-0.009	0.779	-0.088	0.717	-0.074	0.693

Appendix (I)

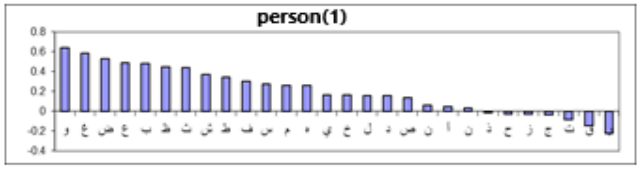
The properties of homogeneity and correlation of peoples who spoke all the Arabic language, Where the x-axis represents the number (1) homogeneity and number (2) correlation.

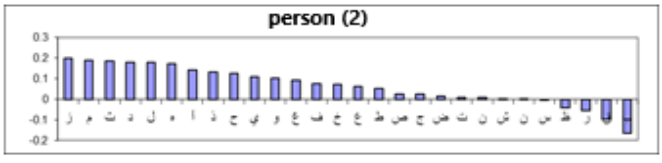


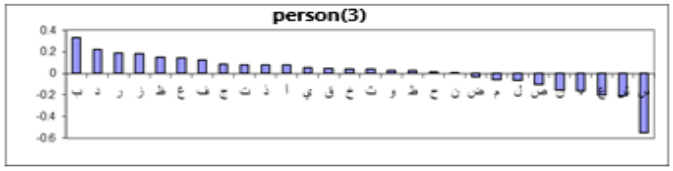
Appendix (II)

Adopting the descending sequence of each property of the Arabic letters spoken by the persons.

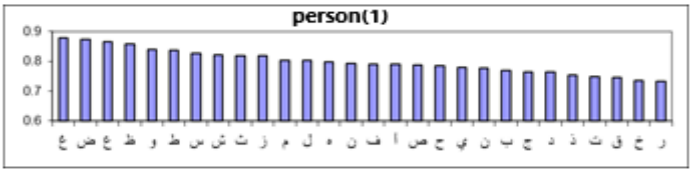
Homogeneity property

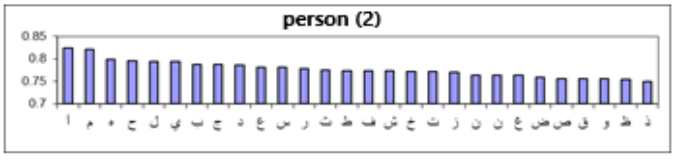


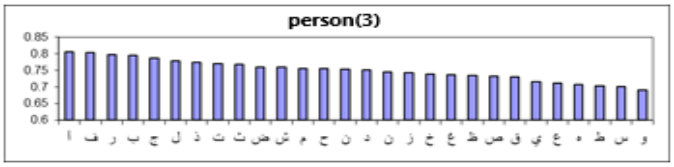




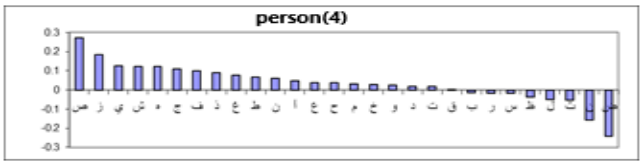
Correlation property

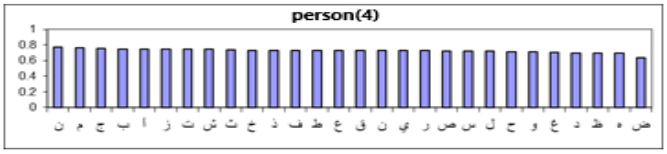


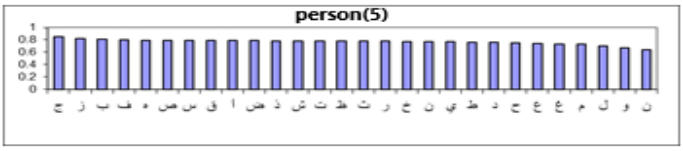


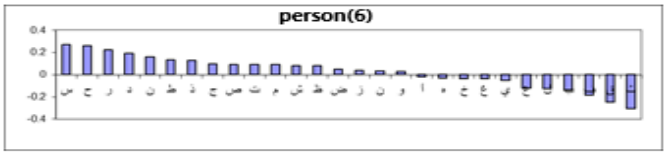


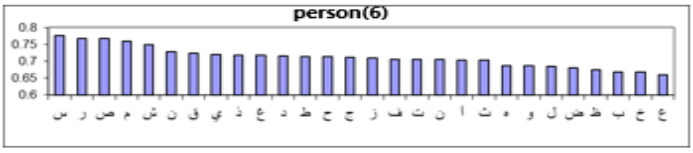
Homogeneity property **Correlation property**

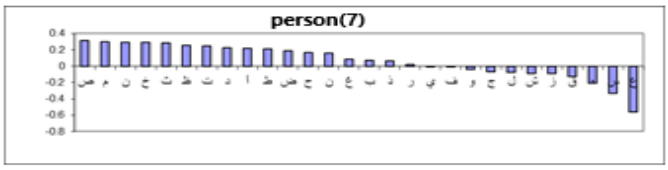


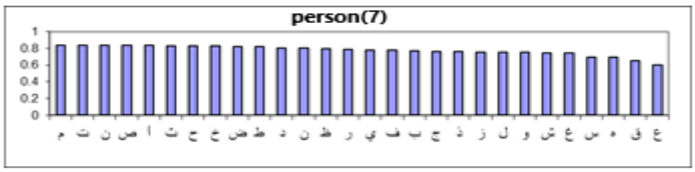


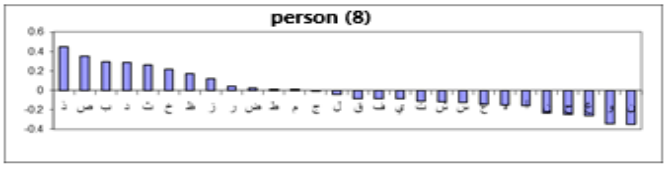


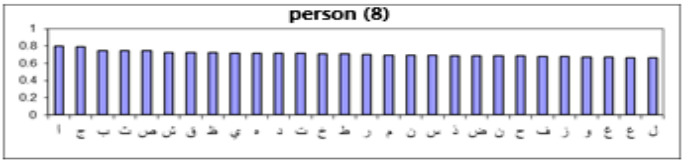


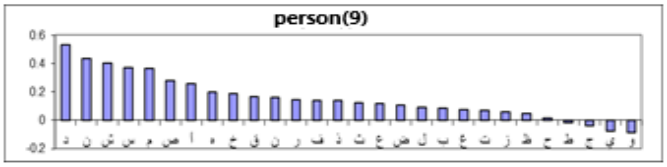


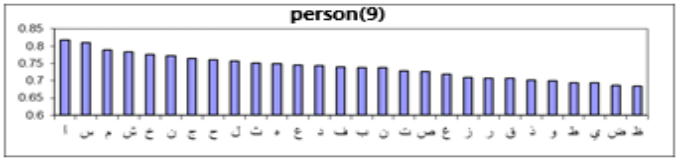






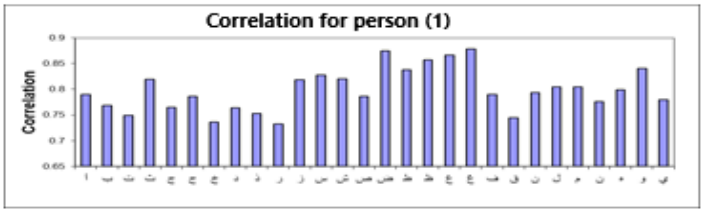


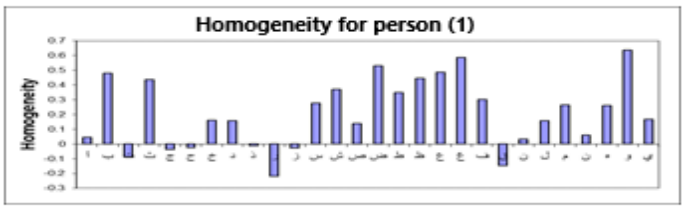


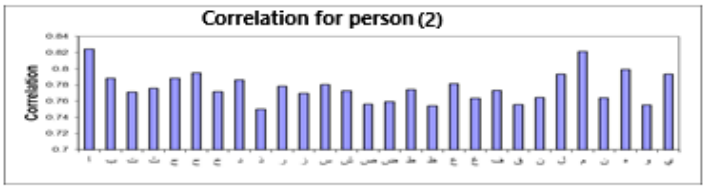


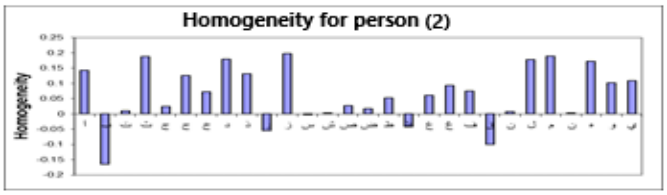
Appendix (III)

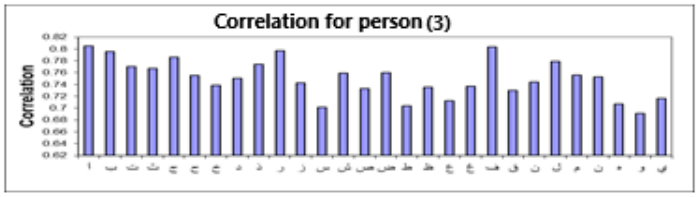
Representing the properties of the operative Arabic letters in alphabetical order

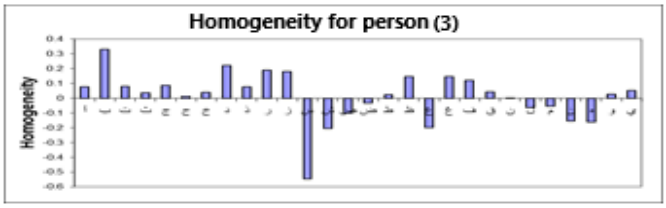




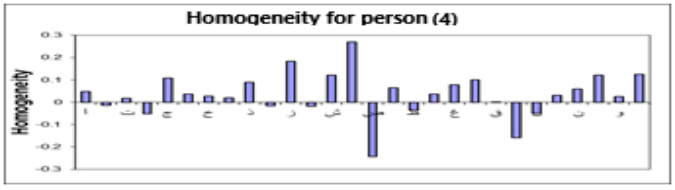

Correlation for person (2)
Correlation

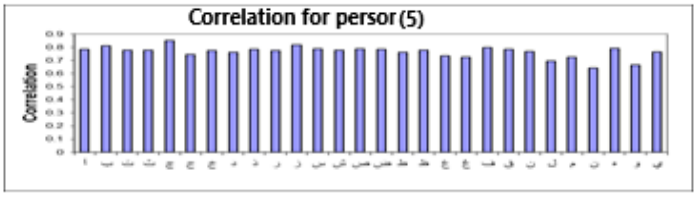

Homogeneity for person (2)
Homogeneity

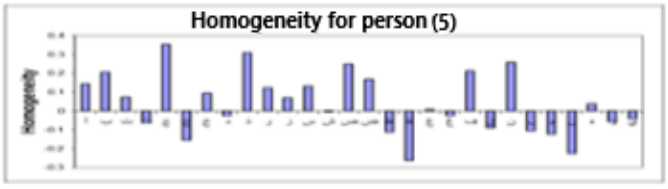

Correlation for person (3)
Correlation

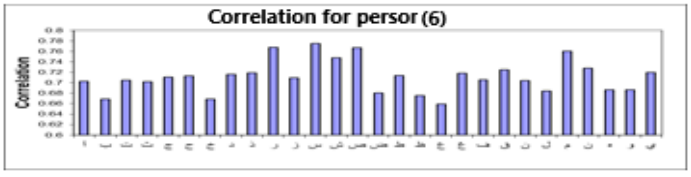

Homogeneity for person (3)
Homogeneity

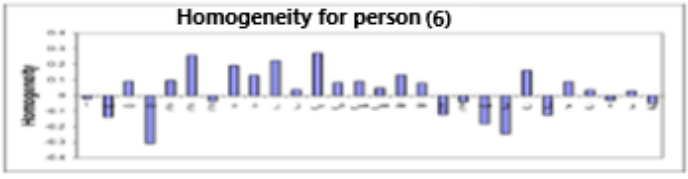

Correlation for person (4)
Correlation

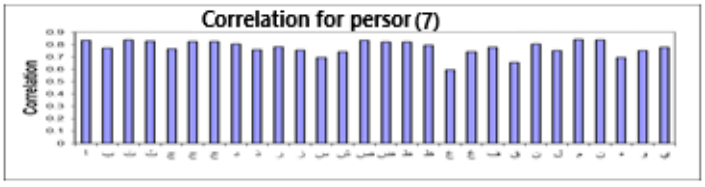

Homogeneity for person (4)
Homogeneity

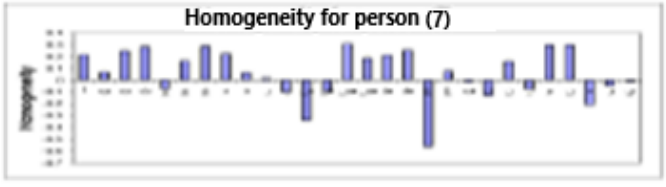

Correlation for persor (5)
Correlation

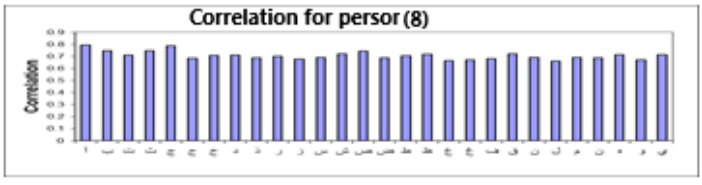

Homogeneity for person (5)
Homogeneity

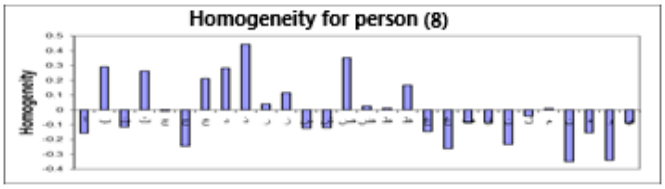

Correlation for persor (6)
Correlation

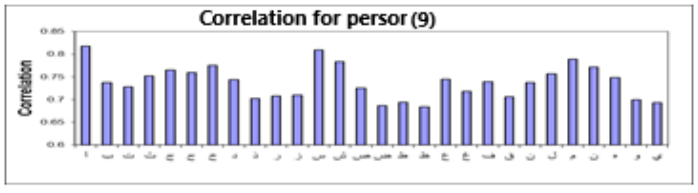

Homogeneity for person (6)
Homogeneity

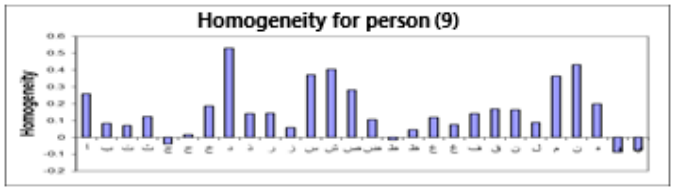

Correlation for persor (7)
Correlation


Homogeneity for person (7)
Homogeneity


Correlation for persor (8)
Correlation


Homogeneity for person (8)
Homogeneity


Correlation for persor (9)
Correlation


Homogeneity for person (9)
Homogeneity

Appendix (IV)

Represents the tree representation of properties, one letter, four persons and rate (average of attributes at each level)