THE STRATEGY OF USING DIGITAL CODING TO FIND THE MAIN SHAPE OF THE TRADITIONAL CITY

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Abstract. Digital coding in the current digital age was used in finding and analysing real prototypes of old cities shapes and plans where this serves as a documentation for the relations forms among the city elements' components, for each city has its planning properties reflecting the architectural and planning identity. Through this study, digital coding for each city planning element will be found to be compared with codes for other cities through using programming techniques in analysing and planning cities. The first level is analysis and finding genetic codes for the cities by using graphic analysis software including AutoCAD, 3Dmaxpro and CorelDraw. Four traditional cities will be selected : Karbala, Erbil, AL Najaf and Mosul, The results obtained in this level ,will be used as inputs for the second level, which is forming and planning the new cities' shape , in addition to rehabilitating parts of the cities to maintain the architectural and formal identity of the city using programming and digital automation techniques. C^{++} programming language will be used to design a hypothetical environment for the cities analysed at the first level. For example, city coding could refer to properties and relation with digital codes that could be understood through the program designed with C^{++} including:
A2A21D3C001S: Iraqi traditional cities code .
A1A22D3D3001: a code for the Arabic cities in general.
A1A22D3D3001S1: a code for the traditional cities in Morocco.
A1A22D3D3001D1: a code for the traditional Arabic cities in Syria.
C6A22D3Z700Z: a code for the European cities in general.
These examples of the codes are simply representing the basic elements and factors for forming the city and when using such codes, cities related to the city identify analysed at the first level will appear .
The main objective of this study is to communicate with the past through the programming techniques that are based on the source city and to form a hypothetical environment for new cities with ancient incomes. Changing such incomes shows us a new shape for the city which is a copy of the original in addition to the possibility of controlling the hypothetical environment of the architectural facades and skyline. In this study we can distinguish the rules and shape relations of the traditional cities in Iraq throughout the selected samples , one of the most important elements is clear centralize and the historical buildings in the centre of these cities .

1. Introduction

In this paper, the shape of traditional city will be discussed only, not the planning or urban design, each city has morphological features upon which researchers use in analysis and construction when asked him to design a new city or renovate an existing one to maintain the formal features. In this study a search is made for formal features of each city and not for constructional features, where city shape will be used in analysis into functional sectors and the relation among these sectors.[1] Each city, according to its social system, consists of many elements which are the basic generator of the city shape. Changing locations of such elements lead to change city's morphology according to various elements including the formal and structural factors in addition to the social factors and the city type (figure 1). Such relations could be found among the elements to be coded and transformed into digital code with formal relations connected with the general shape of each city.[3] There is a possibility of similarity among these codes indicating that these cities have relations among its social , structural shape and city's shape .
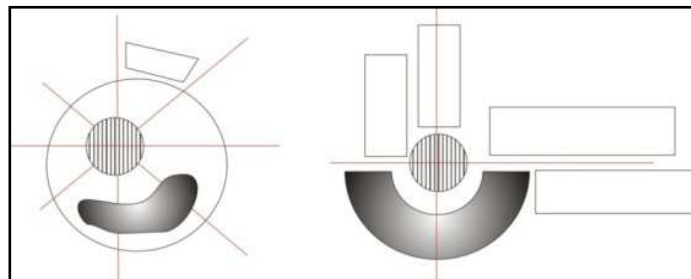

Figure 1 . Different shapes of cities according to the relationship of element.[1,3](re-drawing by researcher)[1]

2. City's shape elements

Cities are formed and developed depending on the first formation. There is ribbon, central, radial and star cities, each of them relied on certain elements in forming the city's shape. These elements may be have various spaces and activities according to the city's type , social and morphological formation. For example, Roman bathrooms are the social centers of the city, while mosque and market are of the vital and formal centers in the Islamic cities.[9]. These elements summarized as follows: center, edge, axes and shape structure(figure 2) .[6]
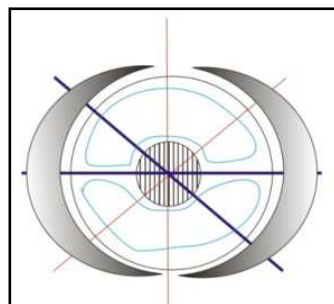

Figure 2. The element shape for general city[6,9](re-drawing by researcher)

(1) Some references and studies needed to simple scheme to achieve the study and we re-draw and draw this scheme depending to the references in the same scheme.

2.1. The center

Traditional city may be have one or multi-centers according to the type of the city's formation. Such center is the city axes and its formal generator where the designer can find a city center at the beginning ,then forming the city. Finding the center can be done through the historical resources and geometric analysis. This center can be found into the traditional city's shape.[7] As mentioned, mosque was the generating center for the Islamic cities, as in the ancient city of Mosul where it took its circular shape originating from the mosque(figure 3), the same case for other sample like Karbala, Al najaf. The historic city center is a group of buildings is its urban fabric or semi full, requires that this center is still vibrant and a lot of old cities and centers still exists and represents the date of online seminars and reflect on the movement continues to grow and develop.[3]
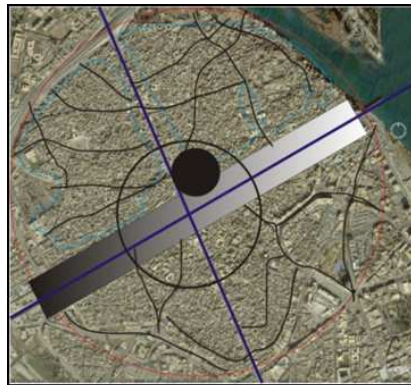

Figure 3. Old Mosul city and main center area and paths .[2]

2.2. Edge

These are the shapes resulting from using certain activities like housing, khans ,..*etc*. this center shapes are changing with city pattern changing[9].
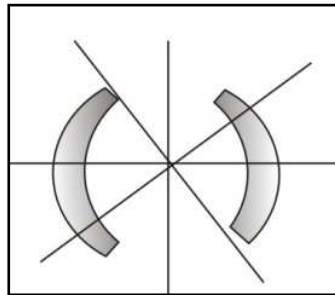

Figure 4. Meaning of the edge.[9]

2.3. Axes

It is one of the important factors of city shape , It represents city growth directions and the second generating axes for the city. Axes could be either radial–intersecting or parallel according the nature of the city [10]*(Figure 5)*.
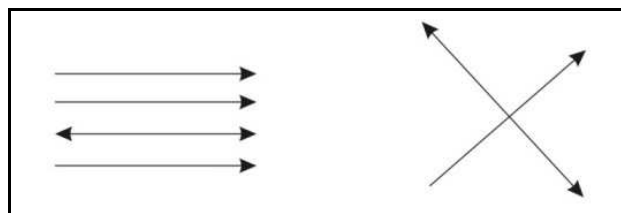

Figure 5. The different type of paths.[10]

2.4. Shape's Structure

      This is the main aspect for the city shape representing the final coating for the city's shape[9]. The main structure for the city while internal structure is the formal cover. [6]
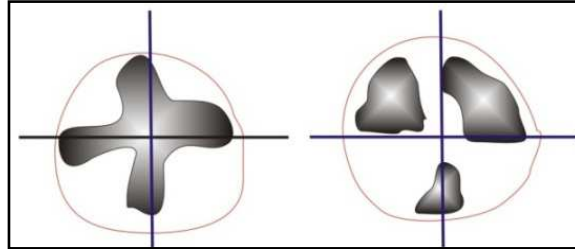

Figure 6. the two type of the main element of the city shape.[6,9] (re-drawing by researcher)

3. What is the digital code for traditional city ?

      Coding variables method to be transformed into digital or genetic codes used in order to derive a mechanism for composing shape in architecture in general. This method is the efficient ones to maintain the genetic shapes in order not to use different features from the certain ones for each city. If any of codes are changed, new cities and shapes will produce . Through reviewing the studies dealing with the mechanism of forming cities, some of these mechanisms are revealed through some of the elements focused on in this study, where each is a digital code for certain variable. Each code could contain other codes as follows:[4]

3.1. central shapes code

      This variable is indicated as (C) referring to the city center shape with cultural and design weight. It is usually the vital center of the city and this code could have two main variables *(Figure 7)*:

- One center referred to as C10.
- Multi- centers referred to as C00.

and consist of the following variables:

a. Center strength referred to as C101 measuring the formal center matching with the vital and cultural city center as follows *(Figure 8)*:

- Match, where it is relative. The center contour is interrelated with the city center contour and referred to as C1011.
- Non–match referred to as C1010.
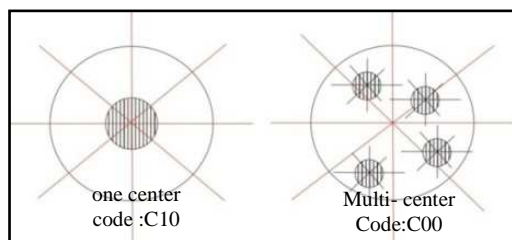- This variable determines the city shape whether central or ribbon–longitudinal.

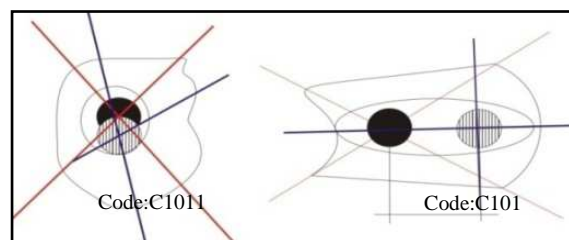*Figure 7. code (C) of the central shape. [4]*

Figure 8. The effectiveness of Center (C101). [4]

b. Shape regulation measure referred to as C001 including (Figure 9):

- Regularly distributed centers referred to as C0011.
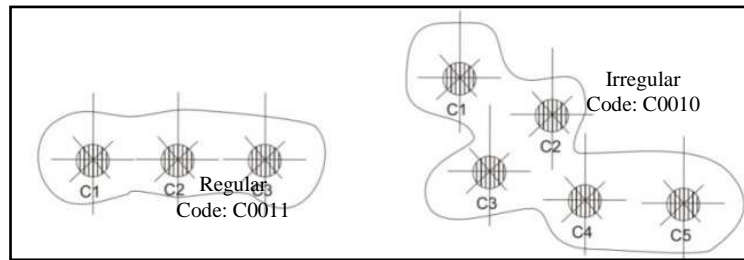- Randomly distributed centers referred to as C0010.

Figure 9. Scheme show the value for regular code (C00). (drawing by researcher)

3.2. city edge shape code
This is referred to as E and consists of three variables for determining city shape:
- Edge continuity E10 consisting of two variables (Figure 10):
  o Intermittent edge E100 when there is multiple city centers.
  o Continuous edge E101.
- Axes intersection E011 consisting of two variables (Figure 11) :
  o Intersecting with axes E011.
  o Locating between two axes E010.
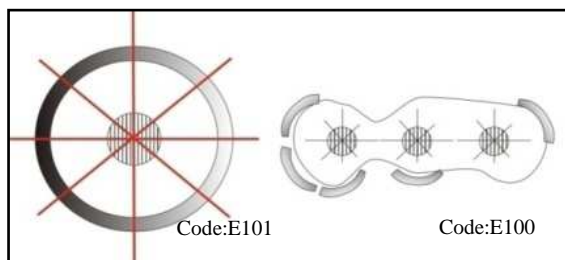
Figure 10. The type of edge that generate the city shape (Code: E10).*(drawing by researcher)*
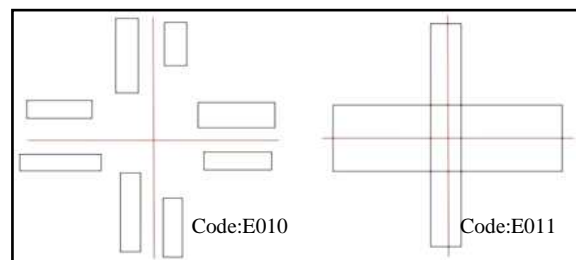
Figure 11. The edge of city shape and crossing the paths(Code:E01). *(drawing by researcher)*

3.3. Axiality code:
It is referred to as A consisting of two variables [10][6]:
- Axes direction A00 consisting of (Figure 12):
  o parallel A001.
  o intersecting A011.
  o radial A100.

Figure 12. direction of paths(Code:A00) .[6]

- Measuring the matching with axes A01 consisting of (figure 13):
  o match with the city axes A011.
  o Non match with the city axes A010.
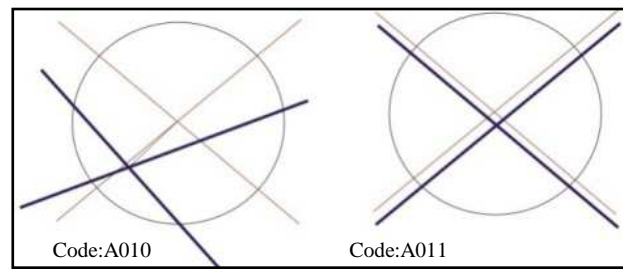
Figure 13. paths regulation(Code:A01).[8]

3.4. Structure of city shape code

It is referred to as R and consists of the following variables *(Figure 14)*:

- matching with center R10.
- matching with edges R01.
- matching with axes R11.
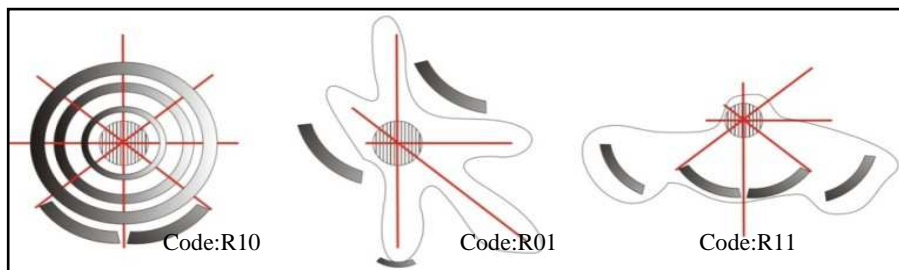
Figure 14. Structure of city shape (Code: R) .[4]
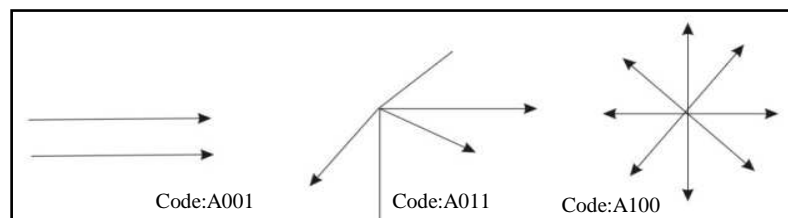
After fixing the codes to be used in establishing the digital line for each city, the next step will include the selection of samples to be analyzed.

Practical Aspect:

Four traditional cities from four various areas are selected:

4. The samples

4.1 The old city of Mosul in Iraq

The old city in Mosul Consists of 4 elements , The squares and mosques, the main axes are shops and the shape structure are mostly residential in addition to the edge , the city is bordered by the river on the one side and the wall of Mosul, on the other side given to a circular shape *(Figure 15)* .

(Figure 15) Traditional city in Mosul . [2]

4.2 Erbil

Traditional city in Erbil contain active urban center that is distinctive shape, a traditional city contain the strong and vital center , this center make the shape of city as circular shape as shown in figure No.16:

(Figure 16) Old Erbil City conceder the core of the new city . [2]

4.3 Karbala

At the center city of Karbala, where mausoleums site combines the city's population and the focus of their lives, the markets surrounding mausoleums and other religious buildings, and clear path extends in front of the entrances so that visitors can pass through it directly to the mausoleums . Advantage of these paths as traditional markets consist of Islamic architecture characters .
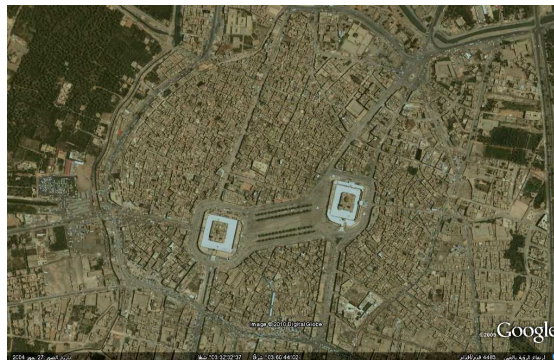
(Figure 17) Traditional area in Karbala . [2]

4.4 AL Najaf :

The old city of Alnajaf consider the Most important traditional Islamic city in Iraq , that contain four main neighbourhoods around the mausoleum , but there are some difference element to composited this city , as shown in satellite image (figure 18)

(Figure 18) Traditional city in Najaf . [2]

4.5 AlKazimiyah :

Kazimiyah is a city of unique as it is a city within a city containing its own center and its traditional form, that the presence of the shrine and wrap the markets and the residential area around it marked the form of the city.

(Figure 19) The center area of the al kazimiyah city and the edge of river . [2]

There are many similar element among the selected sample , if a matching will be made among the images , the results of matching will be generate a new city related with the Iraqi traditional city with some difference .as shown in the image below , there is difficulty vision to mark which Karbala , Mosul ,Erbil …,. the shape or form of city will be analyzed in the next section from this study .

Figure 20 .The objectology of the selected samples. [2]

5. Sample analysis

After selecting the maps for the selected traditional cities, all the plans are entered into AutoCAD 2010 and CorelDraw 4X to be geometrically analyzed using the codes mentioned above. Analysis for city's shape are derive to make codes for each city. These codes will be transformed into digital line that could be used in C^{++} software after reprogramming the requirements for cities design and the new available alternative.

Sample (1) Mosul traditional city
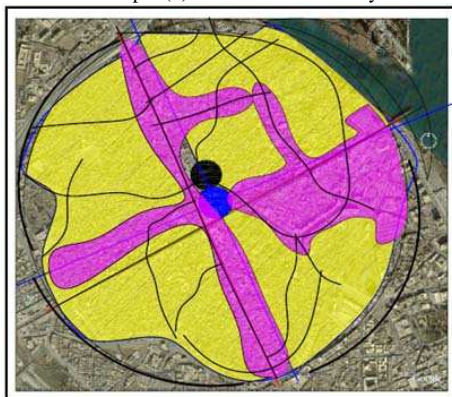
Sample (2) Karbala traditional city
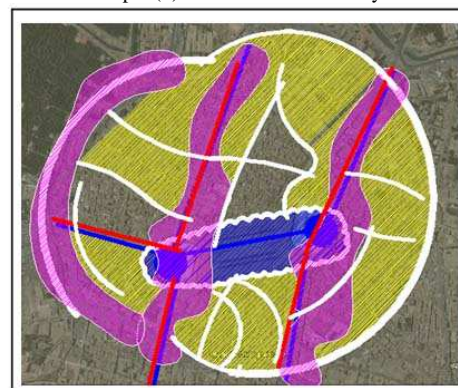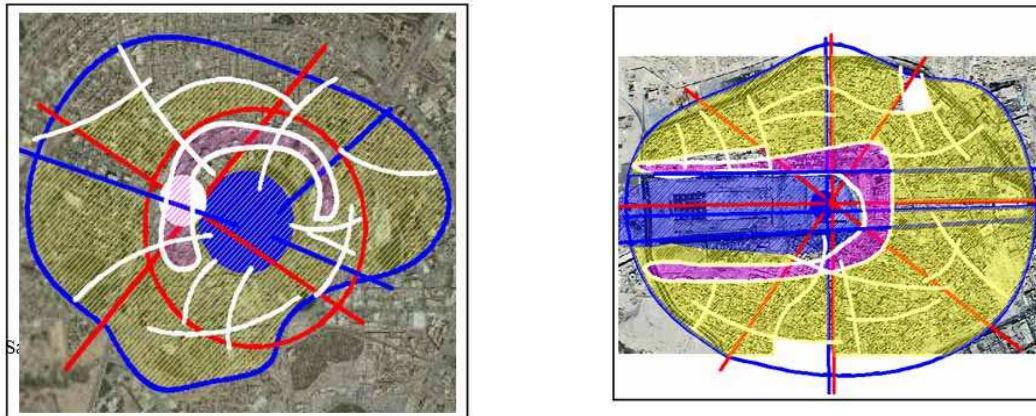
Sample (5) Kazimiah traditional city
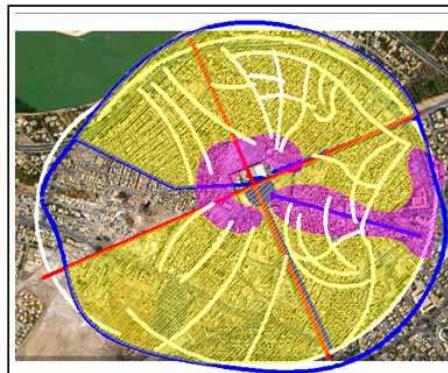
Figure 21. geometrical and Graphical analysis for samples (application study).

From the first look to the top view of the traditional cities , the main shape to create the Iraqi traditional city is the center ,that can use it as a start point to begin the new design , the circular shape and some type of building made the main structure of city . In the next stage in this paper is to find the connective element among the selected samples from Iraqi city and then applying shape can be made to find new shape of city from the connective element , this element can be found by making a table for variable and measure all samples .

Table 1. The value of variation to find the code tape for each sample

| Image of Sample			Sample No:		
			Value of variation		Code tape
Code C Central of city shape	C10 One centre	C101 Effectiveness	C1011 Identical		
			C1010 Non-Identical		
	C00 Multi-centre	C01 regulation	C0011 Regular centres		
			C0010 Irregular centre		
Code E Edge of the shape	E10 Type of edge	E101 Continues edge			
		E100 Non-continues			
	E01 edge & axes	E011 Crossing the path			
		E010 Round the path			
Code A Axes of shape	A00 Direction of axes	A001 Parallel			
		A011 Crossing			
		A100 Radiation			
	A01 axes Regulation	A011 Identical with paths			
		A010Non-Identical with paths			
Code R Structure of city shape	R10 Identical with the centre				
	R01 Identical with the axes				
	R11 Identical with the edge				

Table 2. the value of variation for Karbala traditional city

			Sample No:1 Karbala traditional city in Iraq		
			Value of variation		**Code tape**
Code C Central of city shape	C10 One center	C101 Effectiveness	C1011 Identical		
			C1010 Non-Identical		
	C00 Multi-centre	C01 regulation	C0011 Regular centres		CC00C01C0011
			C0010 Irregular centre		
Code E Edge of the shape	E10 Type of edge	E101 Continues edge			EE10E101
		E100 Non-continues			
	E01 edge & axes	E011 Crossing the path			
		E010 Round the path			EE01E010
Code A Axes of shape	A00 Direction of axes	A001 Parallel			
		A011 Crossing			AA00A011
		A100 Radiation			
	A01 axes Regulation	A011 Identical with paths			AA01A011
		A010 Non-Identical with paths			
Code R shape Structure	R10 Identical with the centre				RR10
	R01 Identical with the axes				
	R1 Identical with the edge				

Table 3. the value of variation for old Mosul city

			Sample No:1 Old Mosul city in Iraq		
			Value of variation		**Code tape**
Code C Central of city shape	C10 One center	C101 Effectiveness	C1011 Identical		CC10C101C1011
			C1010 Non-Identical		
	C00 Multi-centre	C01 regulation	C0011 Regular centres		
			C0010 Irregular centre		
Code E Edge of the shape	E10 Type of edge	E101 Continues edge			EE10E101
		E100 Non-continues			
	E01 edge & axes	E011 Crossing the path			EE01E011
		E010 Round the path			
Code A Axes of shape	A00 Direction of axes	A001 Parallel			
		A011 Crossing			AA00A011
		A100 Radiation			
	A01 axes Regulation	A011 Identical with paths			AA01A011
		A010 Non-Identical with paths			
Code R shape Structure	R10 Identical with the centre				
	R01 Identical with the axes				
	R1 Identical with the edge				RR11

Table 4. the value of variation for Najaf traditional city

			Sample No:1 Najaf traditional city in Iraq	
			Value of variation	**Code tape**
Code C Central of city shape	**C10 One center**	**C101 Effectiveness**	**C1011 Identical**	**CC10C101C1011**
			C1010 Non-Identical	
	C00 Multi-centre	C01 regulation	C0011 Regular centres	
			C0010 Irregular centre	
Code E Edge of the shape	**E10 Type of edge**	**E101 Continues edge**		**EE10E101**
		E100 Non-continues		
	E01 edge & axes	E011 Crossing the path		
		E010 Round the path		**EE01E010**
Code A Axes of shape	**A00 Direction of axes**	A001 Parallel		
		A011 Crossing		**AA00A011**
		A100 Radiation		
	A01 axes Regulation	A011 Identical with paths		**AA01A011**
		A010Non-Identical with paths		
Code R shape Structure	R10 Identical with the centre			
	R01 Identical with the axes			**RR01**
	R1 Identical with the edge			

Table 5. the value of variation for Kazimiyah traditional city

			Sample No:1 Kazimiyah traditional city in Iraq	
			Value of variation	**Code tape**
Code C Central of city shape	**C10 One center**	**C101 Effectiveness**	**C1011 Identical**	**CC10C101C1011**
			C1010 Non-Identical	
	C00 Multi-centre	C01 regulation	C0011 Regular centres	
			C0010 Irregular centre	
Code E Edge of the shape	**E10 Type of edge**	**E101 Continues edge**		**EE10E101**
		E100 Non-continues		
	E01 edge & axes	E011 Crossing the path		
		E010 Round the path		**EE01E010**
Code A Axes of shape	**A00 Direction of axes**	A001 Parallel		
		A011 Crossing		**AA00A011**
		A100 Radiation		
	A01 axes Regulation	A011 Identical with paths		**AA01A011**
		A010Non-Identical with paths		
Code R shape Structure	R10 Identical with the centre			
	R01 Identical with the axes			**RR01**
	R1 Identical with the edge			

Table 6. the value of variation for Erbil traditional city

				Value of variation	Code tape
			Sample No:1 Erbil city in Iraq		
				Value of variation	Code tape
Code C Central of city shape	C10 One center	C101 Effectiveness	C1011 Identical		CC10C101C1011
			C1010 Non-Identical		
	C00 Multi-centre	C01 regulation	C0011 Regular centres		
			C0010 Irregular centre		
Code E Edge of the shape	E10 Type of edge	E101 Continues edge			EE10E101
		E100 Non-continues			
	E01 edge & axes	E011 Crossing the path			EE01E011
		E010 Round the path			
Code A Axes of shape	A00 Direction of axes	A001 Parallel			
		A011 Crossing			
		A100 Radiation			AA00A100
	A01 axes Regulation	A011 Identical with paths			AA01A011
		A010 Non-Identical with paths			
Code R shape Structure	R10 Identical with the centre				RR10
	R01 Identical with the axes				
	R1 Identical with the edge				

6. Results of the study process

After completing the second stage of the research, the digital codes was identify for each sample, the results showed the presence of common codes to the Iraqi traditional cities, as the common shape codes are identified these cities according to the same region ,the ratio of similarity among the samples is 79.8% .the static results .

Table 7. The code for each sample

	C	E	A	R
1	CC00C01C0011	EE10E101 EE01E010	AA00A011 AA01A011	RR10
2	CC10C101C1011	EE10E101 EE01E011	AA00A011 AA01A011	RR11
3	CC10C101C1011	EE10E101 EE01E010	AA00A011 AA01A011	RR01
4	CC10C101C1011	EE10E101 EE01E010	AA00A011 AA01A011	RR01
5	CC10C101C1011	EE10E101 EE01E010	AA00A100 AA01A011	RR10

Table 8. Final code

1	CC00C01C0011EE10E101 EE01E010AA00A011 AA01A011RR10
2	CC10C101C1011EE10E101EE01E011AA00A011AA01A011RR11
3	CC10C101C1011EE10E101 EE01E010AA00A011 AA01A011RR01
4	CC10C101C1011 EE10E101 EE01E010AA00A011 AA01A011RR01
5	CC10C101C1011EE10E101 EE01E010AA00A100 AA01A011RR10

Table 9. Digital code

1	000100111010101010000110101110
2	101011011101010101000110101111
3	10101101110101 01010000110101101
4	101011011101010101000110101101
5	101011011101010101000100010111 0

7. Requirement of the practical study

C^{++} software is used for applying results and codes to derive new alternative for designing traditional cities. All the plans will be entered into 3DMAX to produce the three dimensional models.

The use of the language C + + for application study in practice ,and find the suitability of the results to gain access to an array of codes that can be controlled by programming ,the introduction of codes have been created as constrain when design or re-design a new city-related to original Architecture Identity, and can change in positions of codes to produce our designs Hybrid, In this research, the focus was on shapes of urban reality, however, C + + language is used in many levels through which scientific computing, statistics and engineering, this research has been the experience of using this language to know what for suitability for such so-studies, so is treated the research with this language is a primary can be development in a wider in the future, the development of a simple program has the ability to give alternatives to the shapes of cities, in general through the development of variables within the program with an emphasis on the constants that resulted from the engineering analysis and graphic in the previous stage of the research, The mechanism of process of the Program is characterized its simple requirements , that can be input through the keyboard or mouse, the better method to input data and code is using the keyboard method by making CCP file and programmed all the code and run the CCP file through C++ language (see the CD files , setup the turbo C++ and import the designed file , the run the process. The second method to input the data is by using EXE file directly connected to the AutoCAD and Autolsip program as follows :

When we run the program will appear to us two choices:

1-Locate the center of the shape.

2- Place the second center (when intended to model a city more than one center).

After selected the center will show us a list to determine the axes of the city shape, in this program is installed four types of themes that have been created in the stage of engineering analysis of the samples, as follows: (Figure 22)
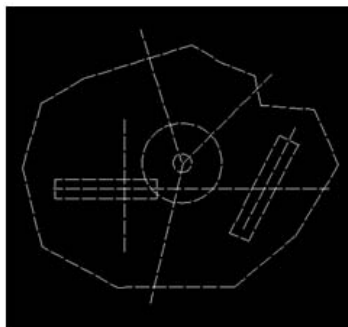
1. Type A
2. Type B
3. Type C
4. Type D

Figure 22. after using C++ (simple model).[C++]

The designer can Pointing one or two types as the designer needing ,Then choose the type of edge will be continuous or non- continuous and their location, by Mouse

The final stage is choose the type of infrastructure to the city shape through three variables:

- with center
- with axes
- with edge

After that activate the program by the run command and produce a scheme for a primitive shape of the city consists of a center ,axes ,edge and an internal structure ,the

designer can be enter the same code resulting from the analysis of the design of new shapes of old cities to change the inputs only, Here you can convert the schema to the software program AutoCAD or 3Dmax to complete the virtual shape to the city by placing buildings and types on the scheme , depending on the designer where he was a model of the sectors of residential buildings in addition to the urban center and buildings of importance for each urban designer(Figure 23).
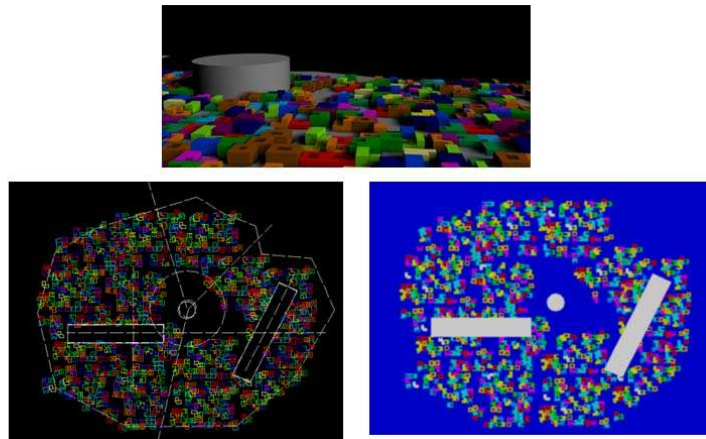

Figure 23. Models for new city formation.(AutoCAD – Lisp –C++)

8.Summary

Each cities generated by a strategy to create its shape, and this strategy vary with place and time, When we see two shape are similar there must be a reason for a similarity between its main shape to create it , when there is a similarity between the tape code of a city with another city could be the reason for their location or community's nature and that the reasons, which can be used programming languages to find this tape or process can be inverted to find cities through tape codes established by the designer depending on the analysis of engineering graphic of the city that wants the designer depending upon taking into consideration the identity of that city. Most of this research are two-stage is to explore the problem through access to studies or previous research and the second stage is the analysis usually end up looking the results of that analysis, engineered his or statistically, in this research we decided that there should be a third stage of research, a stage of application study using a programming language , a C++, one of the languages of the task in an application such as this research, the difficulties that have emerged in this research is to deal with programming languages as architects and planners where it is not easy programming, such as this research without a scientific background and practical programming, so it is important recommendations of this research is to focus on relationship with architecture, engineering and other sciences ,in addition to the code which he can work the program the largest and most variables can be included more precise, effective and this depends on the level of analysis and information available for each study sample. Finally , the main element and relations that can be find in the traditional Iraqi cities are :

1- strong center , as a historical and religion building .
2- direction of main path to the strong center .
3- the city growth around the center .
4- center shape of city identical with the city core.
5- Continues edges , circular shape .

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