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THE STUDY ROLE OF COLORS IN QUALITY OF CITY LIFE AND ITS EFFECTS ON HUMAN BEHAVIOR USING THE FUZZY INFERENCE SERIES (FIS) MODEL: CASE STUDY: ZABOL CITY, BALUCHISTAN, IRAN

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ABSTRACT
Since an important part of human interactions with the surroundings relates to the colors, noticing them as elements which make the environments beautiful is very important for the mankind. Using colors properly in urban spaces, the city appearance will bring us both spiritual and visual peace and improves our perception from spaces. Thus, the purpose of this study was set to evaluate the effects of colors in public spaces of Zabol on reduction of urban vandalism (accidents, gunshots, street fights and knife-cut injuries). Method of this study is descriptive, analytic and survey; also the FIS model was used to analyze and interpret the data. Due to the crucial role of color quality in human behavior, we could conclude that choosing and applying the colors properly in urban appearance, both in terms of beauty and identity, may lead to noticeable decrease of urban vandalism along with increase of urban safety. Statistics showed that if the quality of colors used in public spaces was 0.789 and urban vandalism=0.500, then the safety of Zabol city will be 0.656; in the same way, if the quality of colors=0.500 and urban vandalism=0.500, then we'll have a value of 50% for safety in Zabol city which proves a meaningful-inverse relationship (sig. 0.000) between the quality of colors and urban vandalism.

KEY WORDS: *Colors, Urban spaces, Human behavior, Visual effects of color, Zabol*

Introduction

The term "urban spaces" can be defined in two ways: in one hand, social and artificial spaces remind us on the area of social institutions which is studied by geographers and sociologists; the trend of such view is to see the physical features of artifact environment regarding the physical area; thus, what attracts the notion of architects is the morphology of the spaces, from which the way colors affect our perception and how to use them spatially and meaningfully can be deducted. The urban public spaces provide places for discussing thoughts and building social relationships and networks in which people and social groups are involved. Within such spaces social interactions occur through which information is transmitted and social networks will be formed. But what primarily makes them socially-active is the role of seeming elements which provide a

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ground for the entrance and stand of people and social groups of different ages and genders in there; elements like access, visual attractions and natural scenes (Kiyani and Salari Sardari, 2011). The urban space is a stage on which the story of public life is played; a space which allows all people to access it and act in it. Within such spaces there are possibilities for some social boundaries to be broken and some un-planned encounters to occur through which people can be united in a new social environment (Khademi, Pour Jaafar, Alipour, 2014). In a general definition, the urban space includes the living area of citizens in which people intentionally or unintentionally proceed towards their goals. Streets, boulevards, squares, parks and shape of the buildings which define the area are included in urban spaces and within the area of studies related to the city designs (Soltani and Namdariyan, 2010). Colors and painting is a subject which may have positive effects on giving value and attraction to the public spaces. Besides, colors vitalize the urban context during the day and can make good memories for the passengers. Also, they may affect the security level and increase the time of activities along with improving the behaviors. The most precise scientific definition of color is that color is a visible reflection which is revealed by transmittal, propagation or reflection of a combination of colors in things (Ostovar, 2012). In modern psychology, colors are criterions for evaluating the characteristics as each one of them inspires a particular mental and physical effect in individuals which might be an indicator for their mental/physical status. This subject has been validated by recent developments in physiology and psychology. There is no need to further explanations that from long ago, the mankind has been influenced by the effects of colors in surrounding environments. Such effects have been increasing in the past century by revolutionary changes in color-making industries which include all aspects of our spiritual senses. There have been many researches carried out about the visual comfort (quality of colors) and the city appearance. Gordon Cullen (2008) in his book “a summary of urban image” which has been translated into Persian stated that the urban image includes the art of visual and constructional harmonizing of buildings, streets and places which make the environment of a city (Cullen, 2008). Salehi (2008) in his paper “the indicators of visual comfort and its role in improving the environments” studied the visual relationship between people and the environments which he believes is important in evaluating the quality of each environment. Bell (2006) in his book “The elements of visual designing in architecture” tries to present a comprehendible visual structure for the surrounding world and to familiarize us with the base of designing attractive scenes; he points that the ultimate visual purpose in urban designs is to make an equilibrium between the elements, unification and diversity according to the sprit and place. Alavi (2008) in his book “Lightening in Image Architecture” discussed the proper methods of lightening for increasing safety and security in urban environment. Motevalli (2010) in his paper “Evaluating the quality of beauty in urban image based on the concept of consecutive views” extracts the indexes and elements related to quality of beauty in urban image from the consecutive views within Dar Abad, Tehran and suggests some patterns for improving this quality (Motevalli, 2010). Atashinbaar (2009) in an article titled “Constancy of identity through urban image” studies the identifier elements in urban image and the role of environmental beauty and its effects on urban identity (Atashinbaar, 2009).

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Table 1: The effects of colors on human perception

Effect of color on size of things	Green or blue stuff seem larger than yellow or red ones
Effect of color on distance of things	Green or blue surfaces seem farther while yellow or red ones seem closer
Effect of color on resilience of things	Colors with short wavelengths (violet, blue and green) make things seem flat; colors with long wavelengths (yellow, red) make things seem soft and resilient
Effect of color on temperature of things	Red and yellow are warm colors while green and blue are cold ones
Effect of color on toughness of things	Red, yellow and white are of tough colors while blue, green and black are of soft ones
Effect of color on weight of things	Things of bright colors seem lighter

(Source: Ostovar, 2012)

The geographical location of Zabol which lies in a warm, dry zone beside dust storms in Sistan region altogether made local people rougher in a way that the average of crime statistics has been increasing year by year. But more recently, through a good idea, many public places within the area have been painted again and this caused a meaningful reduction in crime statistics. So, in this paper, we're going to evaluate and analyze the relationship between two independent variables of "crimes" and "misdeed" and the dependent variable of "painting public spaces" by the fuzzy logic.

Area of study

Sistan region with an area of 15,197 km^2 lies in the geographic range between 30 degrees and 5 minutes to 31 degrees 28 minutes latitude and 60 degrees 15 minutes to 61 degrees 50 minutes longitude in southeastern Iran, northern part of the province Baluchistan, by about one eighth of the total area allocated to the province. Average annual rainfall in the region is 6/59 mm, with the mean annual temperature of 22°C and the average annual relative humidity of 38 percent. According to the land classification criteria, it is classified as a dry area. One of the hallmarks of the region is the well-known 120-day winds of this zone which originates in the mountains of Afghanistan and occurs due to the differences of air pressure in plains and mountainous areas. The wind in Zabol mostly blows from early June for about 4 months each year and ends about mid-September or sometimes late August (Municipality of Zabol, 2014).

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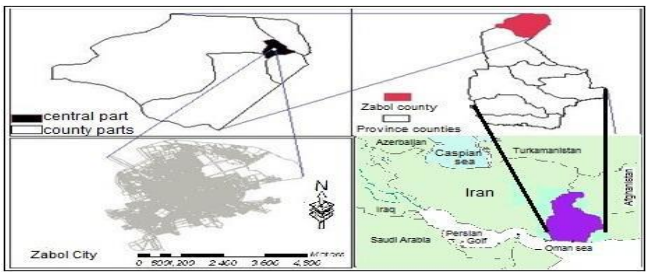

Figure 1: Zabol's position in the region, Sistan-Baluchistan province (Authors, 2014)

Materials and Methods

The method used in present paper is descriptive-analytic and survey. The main data for the research was collected by designing a questionnaire and giving it to the personnel of Zabol's hospital. Then, the data has been analyzed using the SPSS and (through FIS) Matlab software. Population of the study includes data related to vandalism and insecurities of Zabol during 2011-93. There are three indexes here representing urban vandalism: accidents, gunshots and street fights in which other types of weapons such as bludgeons, knives, etc. have been used. On the other hand, the index of painting public spaces is considered to be an element which reduces the insecurity in the town. The relative data was gathered by contacting organizations in charge such as the police, the courthouse and the hospitals, and then processed by "Excel" and "Matlab" software. In the next step, we'll define the proportionate fuzzy sets for all indexes, and then logical rules for combining them and step-by-step inferences of sustainable safety will be determined. Finally, they are given to the Tool Box of FIS in Matlab software, by which the approximate reasoning can be made.

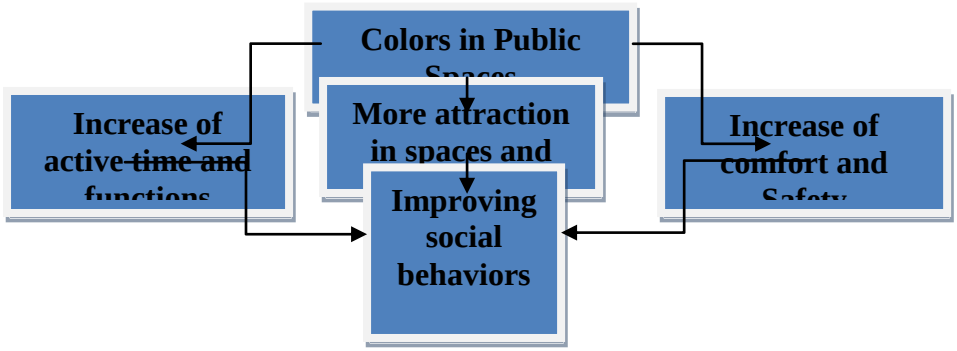

Figure 2: The analytic model of the research (resource: authors, 2014)

Results and Discussion

Colors used in public spaces of Zabol

The embellishment of cities always has been studied by the experts in two dimensions of visual and functional. The functional aspect covers environments, elements, furniture and urban image designs and mostly affects the citizens physically. Recently, the special view of Zabol's urban

administration plans to design urban furniture and signs in order to develop natural perspectives; thanks the business men for their active participation, these efforts have led to decrease of urban vandalism in Zabol.

Figure 3: The role of colors in quality of Zabol's public spaces which inspires happiness and peace (authors, 2014)

Table 2: Elements causing vandalism in Zabol

Cause/Year	2011	2012	2013	2014
Car accidents	123	110	70	29
Gunshots	17	12	7	2
Street fights	18	12	8	3

(Resource: the University of Medical Sciences, Zabol)

Results from analysis of Fuzzy Inference System (FIS)

To infer a unique criterion for evaluating human development in the area requires several levels of fuzzy inference process. At the first level, according to the early classification of the variables, each secondary index will be resulted.

The Knowledge Base

Through designing an expert fuzzy system, first the membership functions (MF) with high efficiency for linguistic variables are chosen; then the input-output of each fuzzy set shall be defined in every level (Database); ultimately, the required knowledge about the subject should be gathered and coded as Fuzzy IF-THEN logical rules (Rule Base).

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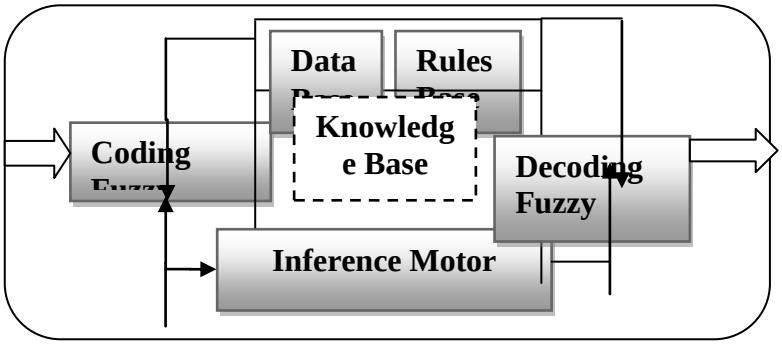

Figure 4: Overall view and main levels of a Fuzzy system

Data Base

Using Triangular shape MFs, three values of low, medium and high have been considered for the two variables of urban vandalism; also, three values of poor, medium and excellent were determined for the quality of colors in urban image. It is illustrated in figure 5.

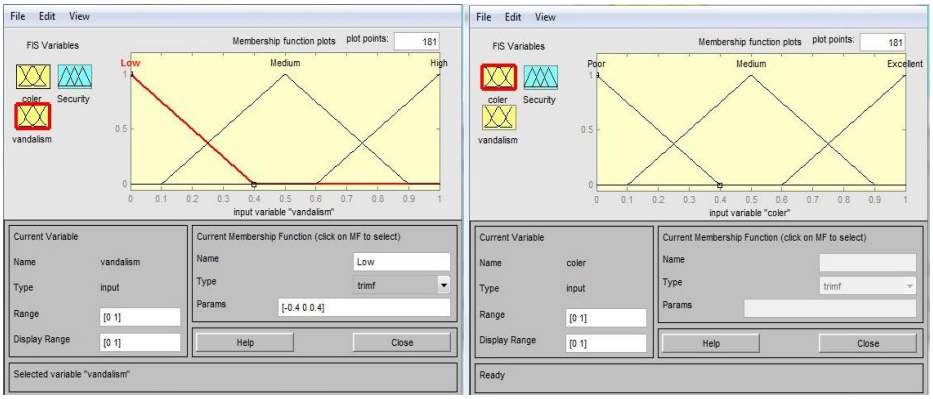

Figure 5: Data Base for variables of urban vandalism and quality of colors in environments (resource: findings of the present study, 2014)

Also, for the urban security index, fuzzy sets with 5 values respectively very low, low, medium, high and very high with the MFs were defined as shown in fig. 6.

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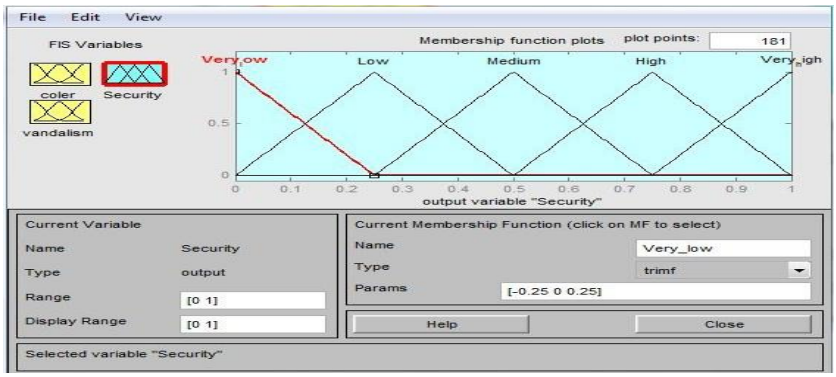

Figure 6: Data Base for the urban security index (resource: findings of the present study, 2014)

Rules Base (logical fuzzy rules)

The most sensitive step in the FIS method is making the Rules Base which provides rules from basic indexes level to the highest human development range. So, here the fuzzy rules related to the effects of painting public spaces on reduction of urban vandalism and increasing the urban security are presented in sketch of MATLAB software.

In fact these rules explain the mutual dependence between the indexes determined for the security and how they interact, affect and are affected. Here is given an example of such If-Then rules:

1) If the quality of colors used in public spaces is poor and urban vandalism, high, then the urban security has a very low degree.
2) If the urban vandalism is low and quality of colors high, then the urban security will be given a very high degree.

All 9 rules related to the urban security are illustrated in figure 7.

Fig. 7: Fuzzy Logic rules related to the variables of the study (resource: findings of the paper, 2014)

As you can see, every rule includes two parts of IF and THEN. The second part always is a noun phrase but the first one usually is consisted of several phrases (called conditions) which are connected by logical “and”. The number of these rules depends on the number of inputs, different levels of varieties, and the type of fuzzy sets defined in Data Base (number of linguistic values related to each primary and secondary indexes and indicators). As it is shown in figure 8, the logical relationship between the quality of colors used in public spaces of Zabol and amount of

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urban vandalism can be studied and analyzed clearly. Since the administrative department of Zabol decided to paint the public spaces in 2013, the amount of urban vandalism caused by elements like car accidents within the city, gunshots and firefights, injuries of street fights and carrying knives and bludgeons, have been decreased significantly in comparison to the year 2011.

Fig. 8: Final results of FIS (resource: findings of the paper, 2014)

The data resulted from FIS for fig. 8 and the histogram (fig. 9) shows that if the quality of colors and paintings of the public places equals 0.789 and urban vandalism=0.500, then the safety of Zabol city will be 0.656; in the same way, if the quality of colors=0.500 and urban vandalism=0.500, then we'll have a value of 50% for safety in Zabol city.

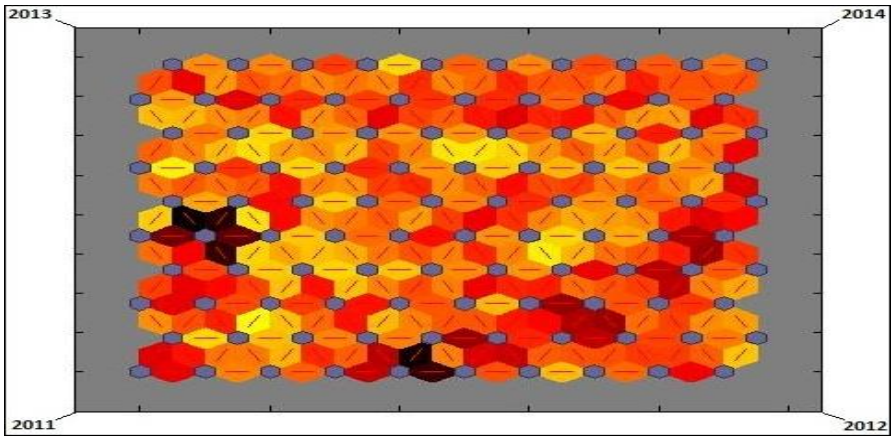

Fig. 9: Final results of FIS (resource: findings of the paper, 2014)

Conclusion

In addition to providing an area for concentrated residency of population and economic activities, the urban environments is where social and cultural relationships are formed; they should meet the needs of citizens. Since the physical shape of the cities affect human perception and behaviors, lack of enough attention to the basic regulations of the urbanism and inharmonic usage of colors within the streets may lead to many disorders and social damages. Due to the effects of colors on human behavior and statistics provided by the University of Medical Sciences in Zabol, it can be claimed

that with the recent activities of Zabol's municipality and other administrative organizations in charge for improvement, renovation and painting old contexts and surface structures of the buildings, the crime statistics in city range has been decreased simultaneously. According to the table 2, it can be concluded that the amount of urban vandalism (car accidents, gunshots, street fights and injuries caused by knives) has been decreasing significantly during the years 2011-2014. Hence due to the relative importance of colors in reduction of crimes, it is necessary to pay more attention to the painting and renovation of old contexts along with the embellishment of buildings' surfaces and other structures. Also, results from the analysis of FIS show that if the quality of colors and paintings of the public places equals 0.789 and the urban vandalism=0.500, then the safety level of Zabol city reaches to 0.656. Final results of this paper show that using natural colors along with domestic materials in the past had given a harmonic, beautiful shape to the buildings within the town. It was also more relevant to the culture and continent of local people. But today using a variety of material and inharmonic colors in construction has brought visual disturbance for the people. According to the crucial role of colors in human life it can be concluded that, using these colors properly, proportionately and harmonically in physical shape of the city, both in terms of beauty and identity, urban designers and planners can solve many problems and social misdeeds in today's city life.

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