Criminogenic Urban Index A Multi-components Index to Estimate the Criminality Degree of Urban Environment Analytical Case Study: Eastern Part of Newark City

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Abstract- **Crime is a serious issue which greatly affects all vital aspects of any country; tourism, economy, education, etc. Thus, it is inevitable to measure it. There are several methods to estimate crime within a certain place, For example, through surveys, official reports, or international non-official index. This paper will propose a multi-components index to estimate the criminality degree within any urban area. First, this paper will gather comprehensive urban components which do affect crime. Second, all effective cases of each component (weather deterrent or stimulus) will be mentioned. Then, a proposed index (criminogenic urban index) will be formulated depending on these effective cases to estimate the criminality degree of any urban area by an index of value ranging from zero to one. Thereafter, the proposed index will be applied on areas within Newark city. Finally, results, conclusions, and recommendations will be listed.**

Keywords - **Criminogenic Urban index - Stimulus urban components –accessibility - Land Use - Parking lots - Crime Rate - Integration Analysis –- Newark city**

I. INTRODUCTION

Crime statistics is a powerful important tool to explain security of counties on different scopes. Many international statistics estimate security of countries depending only on their homicide rate, while others depend on more detailed data published through uniform official reports or taken from surveys and classifies them to property crimes and violent crimes. This paper seeks to propose a criminogenic urban index to measures the extent of which urban areas are stimulating crime incidence through their urban components. Moreover, the proposed index will define those urban components responsible for such criminality effect.

II. CRIME STATISTICAL TOOLS

A. *Uniform crime reports (UCR)*

Some countries publish official crime data through annual uniform reports like the United States which publish its annual crime report by the FBI[1] in the" Crime in the United States series". On the other hand, many countries keep their official crime data unpublished for varying reasons. Yet, in such countries the crime index is estimates by other non-official tools like surveys.

B. *Field survey*

However the results of any survey is not official, they act as a vital and important statistical tool to estimate crime rateeven in areas with published official crime data, as surveys estimate the non-reported crimes which are in some countries more than the reported crimes especially for definite types of crime. Thus, in such cases the results of surveys will be more accurate than official data.

C. *Internationalcrime index*

Another statistical tool to estimate crime rate is International crime index which depends on complementing both official data (if available) and online surveys. One of the most known international crime index is that of "numbeo[2]". Crime index of numbeo is an estimation of overall level of crime in a given city or a country expressed by a number ranging from zero to hundred (0 -100), considering results of crime levels which are lower than 20 as very low, between 20 and 40 as being low, between 40 and 60 as being moderate, between 60 and 80 as being high and finally crime levels higher than 80 as being very high. This index is not annual, yet, it is remade twice per year.

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[1]Federal Bureau of Investigation

[2]Numbeo is the world's largest database of user contributed data about cities and countries worldwide.
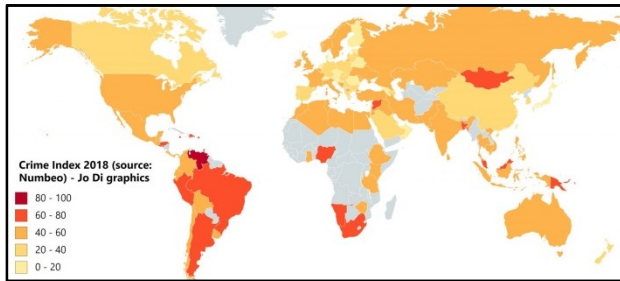
Figure 1: Crime Index (Numbeo) 2018

Source: https://en.jodi.graphics/2018/05/11/crime-index-2018/

III. THE METHODOLOGY OF THE PAPER

The methodology of the paper depends on gathering comprehensive urban components which do affect crime incidence from various scholars and theories to urban crime prevention. Second, all cases for each component which make it either a crime stimulus or a crime deterrent will be listed. Third, the proposed criminogenic urban index will be formulated from these cases with a value ranging from zero to one. Then, this proposed index will be applied to urban areas within Newark city to estimate its criminogenic urban value. Finally, results and conclusions will be listed.
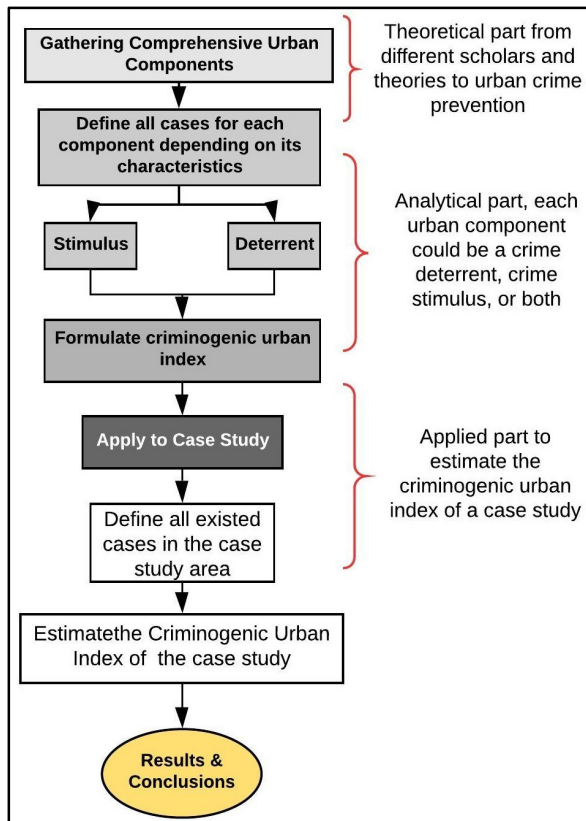

Figure 2: Paper Methodology

Source: By Author

IV. THE PROPOSED CRIMINOGENIC URBAN INDEX (CUI)

The proposed criminogenic urban index depends on gathering comprehensive urban components affecting crime incidence which are (accessibility, opening ratio, section ratio, land use, housing type, urban fabric, entries, road situation, building situation, landscape, furniture, and communication networks). These components are gathered from functional features of different scholars and theories such as "Eyes on the street"1961, "Defensible space", "Broken window", etc.then allcharacteristics which make each component either a stimulus or a deterrent to crime will be discussed.

A. Accessibility

In order to get more accurate results of accessibility, it is measured by integration values of space syntax[3]. Good accessibility could act as both stimulus and deterrent to crime as "areas with high syntactical accessibility have a higher number of pedestrians and car users"[4] which enhance natural surveillance of urban spaces, yet, at the sometime it increases the numbers of probable victims. Thus, the effect of good accessibility whether stimulus or deterrent depends on other component which is land use. On the other hand, segregated areas of bad accessibility act as crime stimulus as most of the space syntax research has shown that crime tends to cluster in segregated areas. To define whether an integration value of any urban area is low or high, it is compared to the mean value of the city; if equal or above the mean integration value of the city it is considered as high (good) value, while if the mean integration value of any urban area is less than that of the city, it is considered as low (bad) value.

B. Opening Ratio

Opening ratio as an urban component refers to building openings whether windows or entryways over streets or urban spaces. Many scholars favor facing building openings to streets or urban spaces as a way to enhance natural surveillance and therefore, deter crime. For example, Zelinka and Brennan who are considered as 'new urbanist' referred in their book "Safescape" 2001to the role of facing building towards alleys in providing more eyes which make them safer. Also Newman referred to the deterrent effect of streets with dwellings opening on them. He referred to a mutual benefit between users of street and dwellers of those building facing it. "The street comes under surveillance from the building, the building entries and lobbies under the surveillance of the street"[5]. It is obvious that there is agreement by two distinct schools on the inverse correlation between openings ration on

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[3]Bill Hillier, Julienne Hanson and colleagues at The Bartlett, University College London in the late 1970s to early 1980s

[4](Penn, et al., 1998; Hillier et al., 1993).,(Shu, 1999; Hillier, 1988).

[5]Bill Hillier and OzlemSahbaz, " High Resolution Analysis of Crime Patterns in Urban Street Networks: an initial statistical sketch from an ongoing study of a London borough"

street and crime. The more the building face its openings to urban spaces, the more these spaces become safer from crime.

C. Section Ratio

Section ration refers to the correlation between building height and street width. The effect of section ratio whether stimulus or deterrent to crime is defined according to the value "1.5" which is the minimum in many countries which define the building height with respect to street width. Yet, with exception for main squares or areas which have especial official restrictions.

D. Land-use

This paper will argue four main land uses versus crime; residential, commercial, mixed use, and parking lots.

1. Residential land-use represents the bulk of any city. It has a deterrent effect which lies mainly in the characteristics of dwellers, for example, their ability to eliminate strangers, their sense of ownership and the extent of their public participation. These characteristics are considered as a kind of natural surveillance "eye on the street" that clearly reflected on strangers and maximize their fear to offend.

2. Commercial land-use are areas often characterized by hustle and dense population during the day, yet, almost deserted at night which made these areas dissociation not only socially but also spatially[6]. For such reasons, commercial zones fall under the category of "crime generator spaces" and "Crime attractor spaces" that would negatively affect the security index not only of their areas, but also of the surrounding urban spaces.

3. Mixed land-use creates multi-purpose urban spaces that attract more users at different time. Yet, it could be a double edged weapon. If mixes land use is functionalized to maximize natural surveillance through more users, it would be an effective deterrent to crime. Many scholars adopted this argument like Jane Jacob " The district, and indeed as many of its internal parts as possible, must serve more than one primary function; preferably more than two"[7]. On the other hand, mixed land use in many cases includes uses that act as crime generator, crime attractor or both. In such cases the negative effect of mixed land use overweighted the deterrent effect of natural surveillance. Newman adopted the negative effect of mixed land use on crime in his book defensible space. He argued that mixed use reduces residential control and therefore increases crime[8]. Thus the key solution to positively functionalize land-use in deterring crime lies in thoughtful mixed-use.

4. Parking lotsexist in many areas especially commercial areas.Parking is a place characterized by relatively low

activities with few users existed at the same time and only for few minutes which lessen the natural surveillance, as well as, cars provide probable hiding places. Moreover, Parking plays a vital role in generating crime[9] because of the increased risk level of victimization[10].

E. Housing Type

Housing type has a notable effect on crime. Defensible space approach[11] argues that residents of multiunit dwellings (apartment buildings) are more likely to experience crime because of lack of territoriality as there are more communal spaces such as common hallways, lobbies, stairwells, and outdoor grounds.Moreover, high-rise buildings are vulnerable to criminal activity because the large number of residents makes it difficult to illuminate strangers or intruders, which subsequently lessen informal surveillance and residents' control.

F. Urban Fabric

Urban fabric is a pivotal urban element which affects the whole characteristics of the area. There is a wide debate around the effect of urban fabric on crime, and which type of urban fabric is safer in comparison to others. Many scholars acknowledged urban fabric with clear orthogonal segments (grid pattern) as it is easier to be perceived and monitored and it is characterized by good accessibility.

Hillier conccluded from syntax studies of residential areas that the safest fabric for residential areas is simple linear with little cul-de-sac. Yet if the number of cul-de-sacs increased so that the area takes the form of hierarchy of cul-de-sacs, it would negatively affect security (flip over effects)[12]On the other hand, segregated or compact urban fabric is claimed to be a breeding place for crimilans which stimulates crimes due to its bad accessibility and its segregated streets network. Yet many emprical studeies proved the invalidity of this hybothesis[13] especially in areas characterised by strong natural surveillence from dwellers. In general, segregated compact urban fabric is characterised by poor accessibility and most of criminal hotbeds have segregated compact fabric as it is safer for them to hide in an area which is difficult to be perceptible and difficult to navigate. In some cases compact urban fabric showed inverse effect, this often found in historic areas or areas with rural style where dwellers act as natural surveillence and can illuminate any stranger.

G. Entries

Entries is the starting point for any user to start perceiving the urban space, thus, locating entries to be clearly visible for all

[6]E.Aksoy, " Geography of Crime and Its Relation to Location: The City of Balıkesir (Turkey)" 2017
[7] Jacob, "Death and Life of Great American cities", 1961
[8]Town & O'Toole. (2005)

[9]Patricia Brantingham and Paul Brantingham, " Criminality of place"
[10]Elizabeth R Groff, Eric Mccord. " The role of neighborhood parks as crime generators"
[11]O Newman(1972)
[12]B.Hillier and O.Sahbaz
[13]Khaled M. Abdelhalim and Dina K. Shehayeb, " Crime Prevention and Urban Development –The Case of Greater Cairo"

users improves natural surveillance of the urban space. Moreover, providing clear entry points improves the access control. Offenders perceive entries not only as starting points of the urban space, but also they perceive them as escape ways after committing their crime. If offenders do recognize that space entries are well monitored by public users, they would retreat to offend for fear of being caught. Another criterion to effectively functionalize entries is their number. Number of urban space entries should be minimized to manage access control. Such thing is also applied to buildings overlooking the urban space; no more than 10 dwellings should share a common building entry[14].

H. Roads Situation

Roads are very important element in shaping the whole space. They are also pivotal urban element in natural surveillance, "The Street, without the continued presence of the citizen, will never be made to function safely for him"[15]. On one hand, roads with poor situation discourage users to use them which minimize the natural surveillance "eyes on the street". On the other hand, deteriorated roads encourage vandalism which by tern increases crime "broken window" theory. Thus, road's situation has inverse correlation with crime, the better the road situation, the lesser the crime.

I. Building Situation

Buildings act as the walls of urban spaces, their situation greatly affect the characteristics of this space. According to "Broken window" [16]theory, building situation has a direct effect on crime. Buildings with good condition give strangers the feeling that dwellers and users of such areas care about their urban spaces. On the other hand, deteriorated buildings make strangers feel that such areas are neglected, un-watched and nobody care about them, thus it encourage offenders to commit crime more easily.

J. Landscape

▪ *Soft landscape "Vegetation"*

Although there are two contradictory ideologies to describe the relation between vegetation and crime, there is a common point that explains this contradiction which is that the effect of vegetation depends on the way of its use; unsuitable and untrimmed vegetation would attract criminals as dense vegetation decreases the risk of being caught by offering concealment[17]. On the other hand, if vegetation is effectively functionalized, it could lessen the opportunity for crime to occur, make criminals feel the risk and discomfort to commit

crime and subsequently it makes urban space a less attractive target for criminals.

▪ *Hard landscape "Sidewalks"*

Sidewalks or footpaths are important urban elements for natural surveillance within urban space as they are designed for pedestrian, and because pedestrian has more effective role in monitoring urban spaces than auto traffic. Many scholars and approaches acknowledged the positive effect of sidewalks on crime. For example: Defensible space referred to the role of footpaths in limiting access and escape opportunities which by tern provide more privacy and increase residential control[18]. Also "Safescape" book which represents new urbanists mentioned that footpaths encourage walking which by tern improve natural surveillance.

K. Furniture

This paper classifies the furniture of urban spaces into three main groups; the first group includes outdoor furniture elements such as Seats and waste bins, the second group includes illumination, while the third group includes signs with its different types.

▪ *Seats and waste bins*

Seats and waste bins can be considered as attractive elements to users. They play a vital role either in maintaining urban spaces or in achieving the "broken window" theory. Thus, their existence in a vandal way could stimuli crime.

▪ *Illumination*

Many theories and approaches mentioned the positive effect of good street lighting in increasing surveillance and informal social control which by turn decrease the opportunity for crime to occur, such as "Broken window theory"[19] and CPTED[20].

▪ *Signs*

Signs are quite remarkable tools to urban crime prevention. Signs are mainly classified in to two groups; traffic signs and security signs, both of them are important in deterring crime. Traffic signs affect greatly users' behavior and contribute to perceiving the urban space in an easier way. Moreover, they help in recognizing the allowable and non-allowable spaces. The second type of signs is security sign. This type focuses on achieving territorial reinforcement by clarifying the non-allowable places. Moreover, it warns of the presence of surveillance cameras that monitor any improper behavior.

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[14]Penrith Development Control Plan 2014
[15]B.Hillier and O.Sahbaz, "High resolution analysis of crime patterns in urban street networks: an initial statistical sketch from an ongoing study of a London borough"
[16]Wilson Vavlasky, Kelling and Kales 1982.
[17]Eric Jaffe (2012), "Can Trees actually deter Crime? "the former New York bureau chief for City Lab. He is the author of *A Curious Madness* and *The King's Best Highway*.

[18]B.Hillier and O.Sahbaz, "High resolution analysis of crime patterns in urban street networks: an initial statistical sketch from an ongoing study of a London borough"
[19]Wilson Vavlasky, Kelling and Kales 1982.
[20]Crime Prevention Through Environmental Design.

Definitely the existence of signs with its two types greatly affects users' behavior and perceiving the urban space. Yet, their effectiveness is conditioned by being in good and maintained condition. The existence of signs in a vandal poor condition would have an inverse effect in deterring crime.

L. Infrastructure (communication network)

Strong communication network allows the victim to ask for help by calling or messaging, or even on the social media. The effect of such technology on crime was clear in many cases. Moreover, the offender in such areas fears to offend, so that any of the public users would take a quick action. On the other hand, area which lacks strong communication network is isolated from its surrounding. So that, offender would exploit such areas to commit crime as he knows there is no way for the victim to call for help. Thus, briefly, communication network has a strong inverse correlation with crime.

V. SUMMARIZING ALL CASES IN THE FOLLOWING TABLE

Urban Components		Cases of each component	S/D*
Accessibility .Navigation		$I\mu_{AR} \geq I\mu_{CT}$, Commercial land-use	S
		$I\mu_{AR} \geq I\mu_{CT}$, Residential, mixed use	D
		$I\mu_{AR} < I\mu_{CT,}$	S
Openings Ratio		Overlooking urban space	D
		Not overlooking space	S
Section Ratio		≥ 1.5	D
		<1.5	S
Land use		Residential	D
		Commercial	S
		Mixed-use (Homogeneous)	D
		Mixed-use (Heterogeneous)	S
		Parking lots(existed)	S
Housing type		Building apartments	S
		Houses	D
		-	-
Urban Fabric		clear orthogonal segments (grid pattern)	D
		Segregated, Hierarchy of Cal de sac	S
Entries		Clear & Few	D
		Clear& Many	S
		Not clear	S
Roads	Situation	Good	D
		Bad	S
Building	Situation	Good	D
		Bad	S
Landscape	Soft "Afforestation"	Create Climbing aid & Create hiding point	S
		Not trimmed & obstacle vision	S
		Well-trimmed & designed	D
		Not- exist	S
	Hard "Sidewalks"	Exist (Good)	D
		Exist (Poor)	S
		Not Existed	S
Furniture	Furniture	Exist (Good)	D
	Elements	Exist (Poor)	S
		Not Existed	-
	Illumination	Exist (Good)	D
		Exist (Poor)	S
		Not Existed	S
	Signs	Exist (Good)	D
		Exist (Poor)	S
		Not Existed	S
Infrastructure	Communication Network	Connected (Good)	D
		Connected (Poor)	S
		Not- Connected	S

$I\mu_{AR}$: Mean integration value of the case study area

$I\mu_{CT}$: Mean integration value of the city

S: stimulus, D: Deterrent

In order to calculate the criminogenic urban scale of an area, first we have to fill out the table form with the urban components cases of the case study are and tick each existing case whether it is stimuli or deterrent. Then, we add the stimuli points and divide them by the total number of existed cases. The resulted value ranges from zero to one.

Criminogenic urban percentage (C.U.P) = $(\Sigma s / \Sigma t)$

Σs: sum of all stimuli cases

Σt: Sum of all existed cases

VI. ANALYTICAL CASE STUDY (EASTERN PART OF NEWARK CITY)

Newark city is located in Essex country, New Jersey State. It is the most populous city in the United States with population 285,154[21] in 2017 on area 67.617 km2 and density 4,424.1/km2.
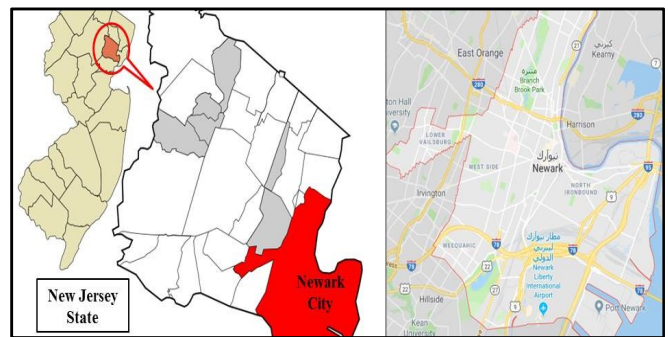

Figure 3: Newark city, New Jersey State

A. The crime Index of Newark city

The annual crime rate of Newark city 34.26 per 1000 residents, with a majority to property crime with rate 25.15 and violent crime rate 9.1 per 1000 residents[22]. This paper will discuss in details the eastern part of the city.

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[21]Population Estimates for New Jersey municipalities, United States Census Bureau.
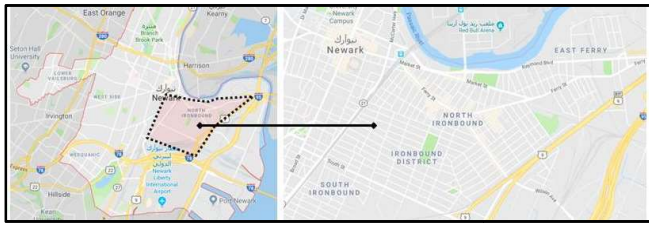[22] https://www.neighborhoodscout.com/nj/newark/crime

Figure 4: Eastern part of Newark city

This paper classifies the eastern part of Newark city to ten areas and shows the crime number of each area. The crime data is taken from official data published online[23]. For a period of time starting from sep 2018till march 2019(6 month) . the taken data is for propoertycrime and violent crime.
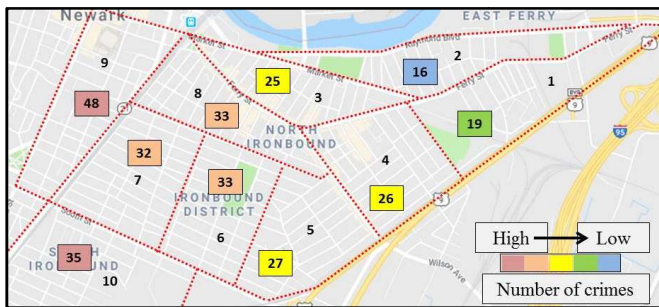

Figure 5: Classifing Crime numbers among areas

Source: By Author

Area Number	1	2	3	4	5	6	7	8	9	10
Property Crime	17	14	21	23	24	28	29	23	42	31
Violent Crime	2	2	4	3	3	5	3	10	6	4
Total	19	16	25	26	27	33	32	33	48	35

Table 1: Crime numbers of areas in the eastern partof Newark city

This classification showed a notable variation in crime numbers among the ten areas. Yet, all areas showed a majority to property crime in comparison with violent crime. This papre will apply the proposed model to two areas with contradicting crime rates; area number (2) with the lowest crime number and area number (9) with the highest crime number.
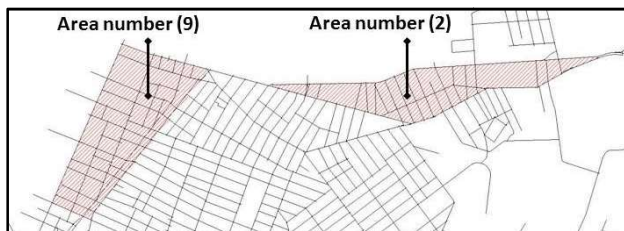

Figure 6: Case study areas

[23]https://www.crimereports.com/

B. Analyzing the urban components of areas number (2) and (9), Newark city

First, the urban components which are the same among the two areas (2and 9) will be mentioned and analyzed whether their effect is deterrent or stimulus to crime, although, they are not the cause behind the varying rates of crime between the two areas. These components are accessibility, section ratio, urban fabric, entries, roads situation, building situation, sidewalks, urban furniture and infrastructure.
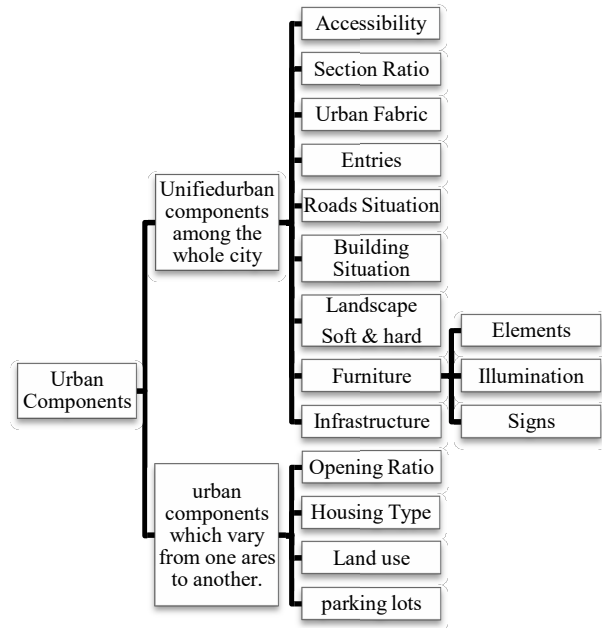
The first urban component which has the same characteristics among the two study areas is accessibility. By executing integration analysis to the axial map of the study area, it was found that the integration analysis of the eastern part of Newark city showed good hierarchy as the streets with the highest integration values are distributed among the whole area which resulted in better hierarchy and high mean integration values for each area (area number 2 and 9) separately. Yet, the accessibility effect on crime will be defined according to the land use of each area.
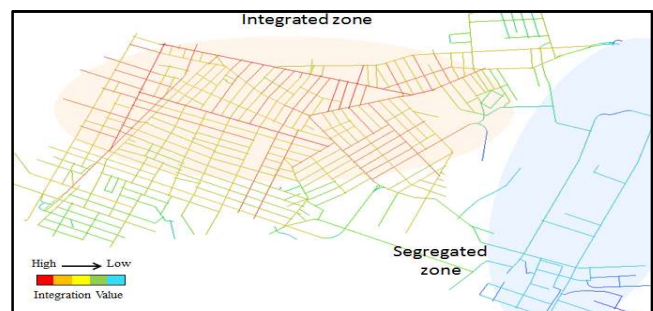

Figure 7: Integration analysis of the eastern part of Newark city
Source: By Author

The second urban component which is the same among the two areas is section ratio. Section ratio of the study area acted as a deterrent urban feature to crime. Area number (2) is characterized by building apartment with limited storeys, while area number (9) is characterized few numbers of houses with limited heights.However, the existence of few tall buildings, they are either surrounded by large parking lots or located on main wide roads.
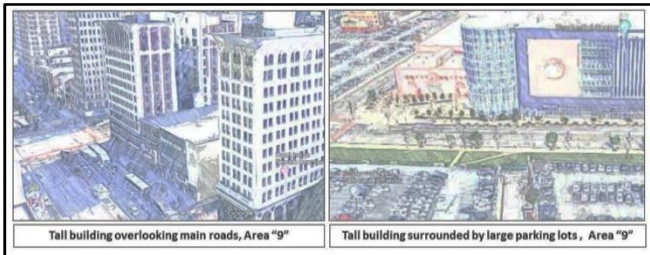

Figure 8: Examples for tall building in area number"9"

The third common urban component is urban fabric. Area number "2" is characterized by multiple grid orientation with orthogonal street network. Moreover, even the size of buildings vary, the spaces between them (streets and urban spaces) are nearly the same.

Figure 9: Urban Fabric (Area 2)

On the other hand, area number "9" is characterized by notable variation in buildings' size, additional to numerous large spaces between them. Yet, the urban fabric of both areas act overall as crime deterrent as there is no hierarchy of numerous Cal-du-sacs.
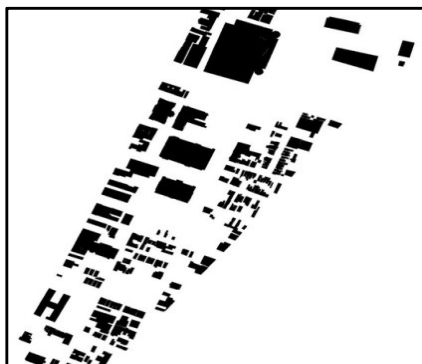

Figure 10: Urban Fabric (Area 9)

The forth urban component is entry. Entries of the two areas act as a stimulus urban element to crime, as they are too many. Area number "2" is surrounded by three main roads with many entries to the area from them.

Figure 11: Entries of area number 2

Also area number "9" is surrounded by main streets with numerous entries from three sides, while it is bounded from the eastern side by a high way. However entries are clear in the two areas, they act as stimulus to crime because of their number.
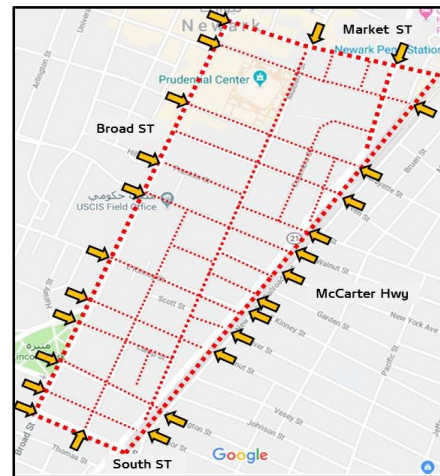

Figure 12: Entries of area number 9

The other urban components which have the same characteristics within the two areas are building situation, road situation, urban furniture, sidewalks, and infrastructure. All these components act as crime deterrent as they exist in good condition in the two areas. Another urban element with the same effect within the two areas, yet stimulus to crime is vegetation. Trees are not trimmed and obstacles vision line in the two areas.
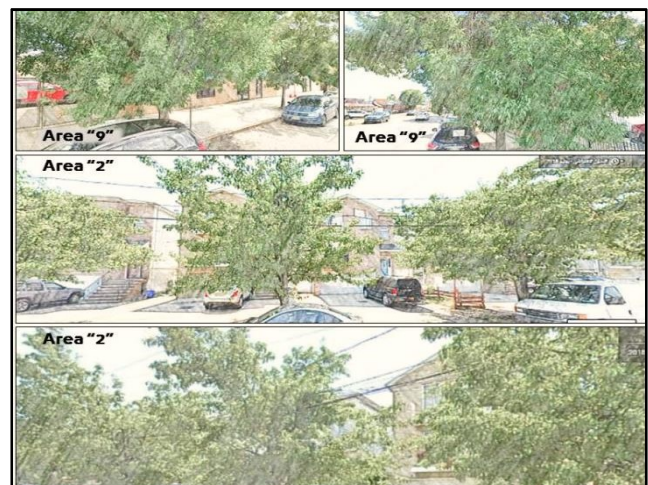

Figure 13: Untrimmed vegetation in areas number 2& 9

On the other hand, there are some urban components whose characteristics differs from one area to another, thus resulted in the notable variation in crime numbers between areas two and nine. These components are opening ratio, housing type, land use, and parking lots.

Area number "2" is characterized by numerous opening (windows and building entrances) overlooking all streets which act as a deterrent urban feature that enhance monitoring urban spaces.
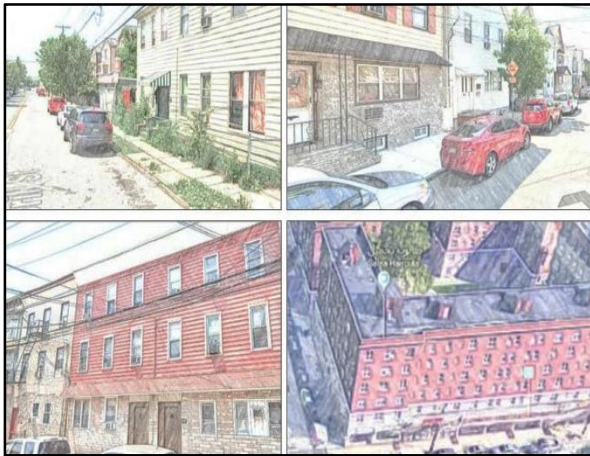

Figure 14: Examples for opening overlooking streets, area"2"

Unlike area number "2", area number "9" is characterized by numerous streets without any opening overlooking them due to the existence of few building and many parking lots which weakens monitoring urban spaces.

Figure 15: Streets without opening overlooking them, area"9"

Housing type is another urban feature that differs between the two areas. Area number"2" is characterized by limited storeys building. On the other hand, even there are few building in area number "9", the area is characterized by two types of housing, separate housing and building apartments, yet with majority to separate building .
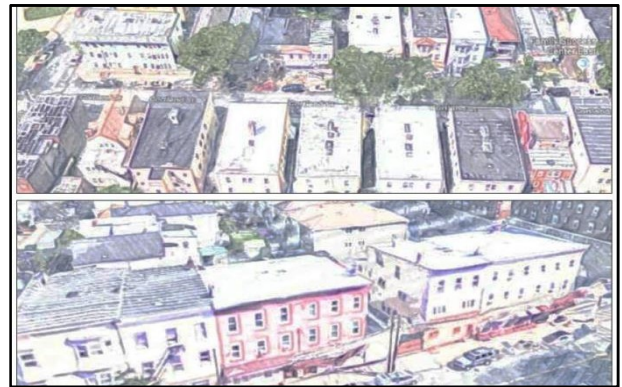

Figure 16: Housing type (area 2)
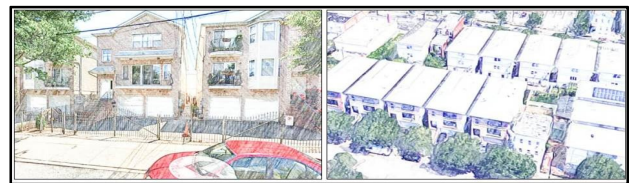
Figure 17: Housing type (area 9)

The last differing urban component is land-use. Area "2" is characterized by a majority of mixed land use with limited commercial zones without large parking lots. On contrary, area"9" is characterized by numerous large parking lots and a majority of commercial use, with limited part of mixed land use. Thus, area nine is classified in to two parts 9A for the commercial land use and 9Bfor the mixed land use in order to be more accurate.

Figure 18: Land use (area 2)

Figure 19: Land use (area 9)

C. Criminogenic urban scale of area (2) and area (9) Newark city
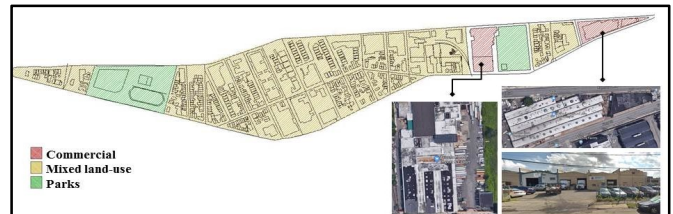
Components		All Cases (for effective components)	Area (2)	Area (9A)	Area (9B)
Accessibility .Navigation		$I\mu_{AR} \geq I\mu_{CT}$, Commercial land-use	S	S	S
		$I\mu_{AR} \geq I\mu_{CT}$, Residential, mixed use	D	D	D
		$I\mu_{AR} < I\mu_{CT}$,	S	S	S
Openings Ratio		Overlooking urban space	D	D	D
		Not overlooking space	S	S	S
Section Ratio		1.5	D	D	D
		1.5	S	S	S
Land use		Residential	D	D	D
		Commercial	S	S	S
		Mixed-use (Homogeneous)	D	D	D
		Mixed-use (Heterogeneous)	S	S	S
		Parking lots(existed)	S	S	S
Housing type		Building apartments	S	S	S
		Houses	D	D	D
		-	-	-	-
Urban Morphology		clear orthogonal segments (grid pattern)	D	D	D
		Segregated, Hierarchy of Cal de sac	S	S	S
Entries		Clear & Few	D	D	D
		Clear& Many	S	S	S
		Not clear	S	S	S
Roads	Situation	Good		D	D
		Bad	S	S	S
Building	Situation	Good	D	D	D
		Bad	S	S	S
Landscape	Soft "Afforestation"	Create Climbing aid & Create hiding point	S	S	S
		Not trimmed & obstacle vision	S	S	S
		Well-trimmed & designed	D	D	D
		Not- exist	S	S	S
	Hard "Sidewalks"	Exist (Good)	D	D	D
		Exist (Poor)	S	S	S
		Not Existed	S	S	S
Furniture	Furniture Elements	Exist (Good)	D	D	D
		Exist (Poor)	S	S	S
		Not Existed	-	-	-
	Illumination	Exist (Good)	D	D	D
		Exist (Poor)	S	S	S
		Not Existed	S	S	S
	Signs	Exist (Good)	D	D	D

		Exist (Poor)	S	S	S
		Not Existed	S	S	S
Infrastructure	Communication Network	Connected (Good)	D	D	D
		Connected (Poor)	S	S	S
		Not- Connected	S	S	S

Table 2: Criminogenic urban index of case study areas

VII. RESULTS

City	Newark		
Area Number	2	9A (Commercial)	9B (Mixed use)
Number of crime	16 In 6 months	48 In 6 months	
Stimulus urban components	Entries, Housing type, vegetation	Accessibility with land-use, Opening ratio, Soft landscape (vegetation),parking & entries	Opening ratio, Soft landscape (vegetation), & entries
Criminogenic urban index	0.21	0.43	0.21

Table 3: results of case study areas

By applying the proposed index to case study areas in Newark city in the United State, it was found that the worst criminogenic urban scale which is equal to 0.43 is that of the commercial area number (9A), while area number (16) and the mixed land use zones in area number (9B) showed better result which is equal to 0.21. Yet, overall the worst criminogenic urban scale stills less than 0.5, this is because all areas are characterized by good built-up environment represented in building condition, roads, infrastructure, sidewalks, and urban furniture.

VIII. CONCLUSIONS AND RECOMMENDATIONS

There are many statistical tools to estimate the crime rate of countries or cities, some depends on official data, while other do not, yet the complementing of both would give more accurate results. The difference in the proposed tool (criminogenic urban index) is that it estimates the criminality degree of any urban area depending on the characteristics of its urban components. Thus, it acts as a preventative and proactive tool rather than a statistical one.

Most of urban componentsof the proposed index (CUI) could act either as stimuli or as a deterrent to crime; it depends on the characteristics and the conditions of each. Moreover, the correlation between them is very important to estimate their effect on crime as there are some components which cannot be classified as stimuli or deterrent separately.

From the analytical case study, it is concluded that; there are common urban components in the two areas. Yet, their effect on crime vary either as a stimuli like vegetation and entries, or as deterrent like urban fabric, roads situation, building situation, furniture, and infrastructure.

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