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Utilizing participatory mapping and PPGIS to examine the activities of local communities



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Abstract Ensuring the city resiliency, inclusiveness, sustainability, and enhancing the quality of urban living, can be promoted through engaging communities and encouraging civic-led initiatives. As cities need to foster environments that encourage collective community voices in order to be adaptable and resilient, as a result of rapid Urbanization process, the growing communities suffers from a declining sense of community. This Research is concerned with studying the effect of participatory mapping and empowerment role of citizenship in enhancing the planning process. Therefore, it is an attempt to assess the social and spatial experiences of local community, aiming at investigating the relationship between local community activities, their perception of built environment and their sense of community, through using Participatory GIS. As it is an effective tool that provides spatial complexity, spatial context, interactivity and interconnection in the articulation of context and capable of deepening our understanding of quantitative measures. To achieve that, a methodology is adopted employing participatory mapping and Geographic Information Systems (GIS) to examine the activities of locals in the neighbourhood with lowest score of sense of community index resulting from a quantitative survey formed of sense of community index (SCI), applied on two neighbourhoods in Alexandria city, Egypt.

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1. Introduction

Urbanization is not a modern phenomenon, but a rapid and massive process that is visibly reshaping both the developed and developing countries. This growing urbanization requires significant transformations as every city is different and face unique challenges due to the urbanization process. In order to ensure the city resiliency, inclusiveness, sustainability, and enhancing the quality of urban living, this can be promoted

through engaging communities and encouraging civic-led initiatives. Both top-down and bottom-up development planning have increasingly revolved around communities and neighbourhoods. In the face of that opposition to a variety of development efforts, planners and stakeholders alike now require extensive information about the Qualitative and Quantitative characteristics of communities and their residents. Spatial information is essential to analyse these locals' priorities, perceptions, and preferences in order to achieve socially-acceptable decisions. Accordingly, to the social dimension of the UNESCO 2030 Agenda on social inclusion targeting inclusive policies for cities, as well as the participatory decision-making by strengthening the link between communities and

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their built environment in order to sustain vibrant cultural lives and the quality of urban environments [1]. Thus, Cities need to boost environments that encourage collective community voices in order to be adaptable and resilient. Therefore, the planning and design process must be comprehensive by engaging local communities and citizens throughout the process.

Life conditions of modern cities such as smaller family networks, spending less time with the community resulting from huge working hours, increased social media use, and the lack of safety in cities this could be associated with declining sense of community [2–3 4]. Cities of developing countries like Egypt suffer from declining sense of community which is clearly observed in the growing communities due to rapid urban growth and urbanization process. This decrease is usually linked with the community quality or the physical attributes of the neighbourhood [5]. In Alexandria, many evidences on the decreasing quality of neighbourhoods could be observed. For instance, many of the city residents are suffering from noise, air pollution and poor quality of the public transportation system resulting from over population [6]. UNDP [7] states that Alexandria contains 29 informal areas which representing about 2.9% of the informal settlements of Egypt. About 1.4 million representing about 35% of the residents of Alexandria, live in these informal areas. In addition, the number of informal buildings has been increasing in the city's neighbourhoods. Deteriorated built environment in the residential areas. All these factors are contributing to low sense of community. while the Sense of community is a concept in community psychology and social psychology, as well as in several other research disciplines, such as urban sociology, which focuses on the experience of community rather than its structure, formation, setting, or other features. The common sense idea of sense of community is derived from images of the past that are projected as idealized forms of living [8]. Many researchers determined and developed different definitions of sense of community and studied its relationship with many factors. The most accepted model of sense of community comes from psychologists David McMillan and David Chavis [9], who used factor analysis to identify four main elements of sense of community: membership, influence, Integration and fulfilment of needs, and shared emotional connection. Based on these elements, they defined sense of community as “a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together” [9]. The majority of studies explore the relationship between sense of community and the physical form of the community. However, there is less research exploring whether social interaction within communities varies according to neighbourhood design [10]. These researcher's critic the great attention of physical attributes of built environment and the neglecting of the importance of some other features correlated with sense of community like social interaction, history of the place, immigration, walkability and economic level [11]. In fact, both the social and spatial context are very important in strengthening the sense of community in the neighborhoods. Thus, this Research is concerned with studying the effect of participatory mapping and empowerment role of citizenship in enhancing the planning process. Therefore, it is an attempt to assess the social and spatial experiences of local community. Aiming at investigating the relationship between local commu-

nity activities, their perceptions of built environment, and their sense of community, through using Participatory GIS. It is an effective tool that provides spatial complexity, spatial context, interactivity and interconnection in the articulation of context and capable of deepening our understanding of quantitative measures. The research is based on an inductive methodology, applying the following structure; first, defining the domains of sense of community, in order to classify the most important domain that had a great effect on sense of community index (SCI), and how it affected the results of quantitative measure. Then focusing on place-based approach how it could be used to examine the participants sense of community, finally, the importance of combining the public participatory GIS in deepening the spatial and social context of neighborhood.

2. Sense of community dependent variable

The Sense of Community Index (SCI) has become the most quantitative measure used in analysing the sense of community in the social sciences. It has been used in different context in North and South America, Asia, Middle East, as well as many as in urban, suburban, rural, universities and, across different scales. Based on two main measures developed by David McMillan, David Chavis [9] Sense of community index and Kim and Kaplan [12]. They gave a full description of sense of community and resume the work of previous researchers. Showing that the domains of sense of community have a range of social to collective characteristics and also another range of physical to psychological characteristics. The Research done by Kim and Kaplan [12] created the basis for which the social and physical dimensions of sense of community can be tested, the framework identifies four domains, which are proposed to relate to an important aspect of residents' feeling to the community. The framework broke the physical and social domains of sense of community into four contributing domains as follows; 1- Community or place attachment, refers to residents' connections to their community; 2- Community identity, refers to personal and public identifications with a specific community with its own character; 3- social interactions, is defined as formal and informal social opportunity in which residents participate to the quality of their relationships; 4- pedestrianism implies that a community is designed for walking and encouraging street side activities. However, all these domains consist of some subcategories and are interconnected in several aspects [12]. Each subcomponent has been presented by some factors as follows;

Community Attachment; It refers to residents' connections to their community, the sense of feeling at home in one's community can be expressed in a variety of ways. This domain mainly measures; Bonding with community, it is then analysed to *Subcomponents*; community satisfaction; when local residents find their homes and community satisfactory, then they experience a strong sense of community attachment. Connectedness; residents feel attached to their community when it recalls their personal and community history, tradition and familiar environmental characteristics. Sense of ownership; long term local character, residence helps lead to long-term social integration into the local area, and such integration creates an emotional bond between residents and their homes and community integration [12]. Thus, *Place attachment* is the key domain of sense of community, this domain expresses the way

in which residents feel at home and their belongings to the community.

Community identity; It is defined as personal and public identifications with a specific physically bounded community with its own character, although social dimensions of identity have received considerable study [13], many of the characteristics of identity can also find expression in the physical environment. *Mainly*, it implies the local features of the built and natural environment characterize a physical identity of place. It is then analysed to *Subcomponents*; Uniqueness, “being different” from others through associating with a group or a place. Continuity; physical properties of community that keep link between residents’ past and present environments. Significance, Congruence; exists when the built environment facilitates the daily life of users and enhancing their quality of life.

Social interactions; It is defined as formal and informal social opportunity in which residents witness to the quality of their relationships, it measures how locals being involved in community, it is then analysed to *Subcomponents*; Neighbouring; interactions with residents living to them. Causal social encounter; informal social contact between residents. Community participation; interactions in community issues or engagement in community problems, related activities and social support [14].

Pedestrianism; It is a modulation that a community is designed for walking and encouraging street side activities, it measures degree of knowing community, it is then analysed to *Subcomponents*; walkability; the community’s physical environment is conducive to more walking and less driving, pedestrian, connectivity, Mass transit, pedestrian scale/street- level activities.

According to what is mentioned above, it is noticed that, the community identity and community attachment are meaning-based, pedestrianism and social interaction are activity-based. This leads to the study of places-based theory in enhancing sense of community.

3. Place-based approach

In place-based research, it is an approach that tend toward more comprehensive methods of involving local communities and individuals in a process called participatory mapping [15,16]. Kevin Lynch, Early work in this area, was conducted by investigating participants perception in three different cities sketching maps showing significant features of their cities and the implication of these elements on their maps [19], as he was interested in how people organize spatial information about their built environments. Recent work by Coulton, Korbin, Chan and Su [18] examined various methods of defining neighborhood units based on pre-drawn maps by residents and found that these maps covered different spaces and produced different aspects on different social indicator data such as; sense of community, neighborhood crime and poverty. Moreover, to enabling the empowering and engaging, through people drawing their own maps, as opposed to relying on pre-drawn maps or census boundaries, this method allows the researcher to understand what types of spaces and activities are most important to individuals’ daily functioning and well-being. Similar to other participatory research measures used to examine physical and social space, such as photovoice, participatory mapping can be useful in challenging assump-

tions and testing theories of what people appreciate in their community and what they contribute to them. Cities are the primary living environment for humans, so enhancing and providing a good quality of life for urban dwellers is becoming of an essential need. The spatial configuration of cities has an impact on analysing the activity pattern and thus, the movement of citizens and help in the fulfilment of users need which should be considered by urban planners as an important tool for decision making. There is a crucial need for new tools and methods that would support planning with better knowledge of how cities function, the factors affecting the urban quality of life, as well as social, environmental, and economic outcomes and conditions of planning decisions, instead of traditional planning methods. Lately, urban planners participated in the initial characterizations of PPGIS as, it provides a unique approach for engaging people in decision-making by incorporating local knowledge, integrating and contextualizing complex spatial information from user point of view. It allows participants to dynamically interact with input, analyse alternatives, and it empowers individuals and groups to share their experience.

3.1. Public participatory geographic information system (PPGIS)

The term Public participatory geographic Information system (PPGIS), was mainly meant to broaden public involvement in policymaking benefiting from the capabilities of GIS. In 1996 and 2006, at the two meetings of the National Center for Geographic Information Analysis (NCGIA) the importance of public participatory GIS has been highlighted [21]. Focusing on different approaches and methods to engage public in applications of GIS with improving the transparency process and how these methods could influence the governmental policies [20]. The concept of PPGIS and its importance has attracted researchers from different disciplines such as; urban planning, community development, landscape ecology and those of natural resources [20]. The PPGIS projects was found to be crucial in supporting different stages of a collaborative planning process, by enhancing the quality of input data through disseminating planning-related information, expanding the number of stakeholders in planning, easing the understanding of analyses through visualization and weighting alternatives using graphical interfaces [22]. Recent work has expanded the participatory mapping technique by combining it with GIS to create participant activity spaces, as using GIS in participatory planning activities is very useful as it is capable of providing spatial context and complexity, articulation of spaces through analysing both interactivity and interconnection [17]. Different Activities performed by users represent the spatial movement component of individuals’ day-to-day lived experience. This is a powerful tool that can be used to measure and represent the geographic accessibility, mobility, and place identity. Also, the size of the activity space is a quantifiable measure of individuals’ community engagement and participation, and it has been found to be significantly associated with quality of life, sense of community [17]. With the increasing emphasis on the social and environmental sustainability, and the global great attention to community-level planning, GIS needs to move beyond conventional representations of where people live to describe more

effectively the dynamics of how people live. GIS maps with multiple layers of information that include all features of a selected area, such as schools or green spaces, are now widely recognized as representing a collective reality. But the debate is all the residents of a community interact in the same way with every school or park in their region in reality. Otherwise, the identified locations are needed to be collected accordingly to participatory information, their connections with the physical surroundings. Which is the product of their unique priorities, perceptions, preferences, and potentials. In other words, populations are not homogenous, and where people live only forms a starting point for how and why they live there. The processes of data collection, integration, and map creation using GIS and participation-based GIS, have only recently begun to change in response to these distinctive dynamics of community development, and in enhancing the quality of life in these communities [25].

4. Methods and tools

To achieve the research aim, a proposed methodology was adopted employing participatory mapping and Geographic Information Systems (GIS) to examine the activities of locals in the neighbourhood with lowest score of sense of community index (SCI), as activities represent the spatial movement component of individuals' day-to-day lived experience and can be used to measure and represent geographic accessibility, mobility, and place identity, comparing the results of PPGIS with the results of survey formed of sense of community indices (SCI), according to Kim and Kaplan theory, to deepen our understanding to this survey applied on two neighbourhoods in Alexandria city, Egypt. As shown in Fig. 1. The chosen Neighborhoods were selected based on differences between them in three independent variables; built environment, economy and history of the neighborhood. Depending on these

variables, the two neighborhood were selected starting with the historical development of the city and the social economic levels of each neighborhood. The two neighbourhoods exhibit different socio-economic conditions and historical 'back-grounds' Fig. 2

4.1. Study area

The Two chosen Neighborhoods exhibit different socio-economic conditions, and physical built environment; Kafr Abdo and Kom El dikka. Kafr Abdo is considered as a high socio-economic residential neighborhood, the area has been developed between 1900 and 1930. The neighborhood is distinguished by having landscape elements, villas and residential buildings but, nowadays it is suffering from removing some of its ancient historical villas and establishing new buildings which threatening the quality of the place. The original name of Kafr Abdo Street was Marshal Allenby, a British Field Marshal appointed High Commissioner of Egypt in 1919. The street connected the Rosetta avenue (later known as Abu-Qir or Horreya road, a major artery crossing the city from East to West), to the top of Abu Nawatir hill where Marshal Allenby had his residence and headquarters. The street basically led to his residence and the park that still holds his name. It has a population of 72,000, population density 882 and total density 115, Tenure system is divided into ownership 95.3% and new rent 4.7% system shown in Fig. 3.

Kom El Dikka is the oldest neighborhood at heart of the central business district of Alexandria, the area is established between 1800 and 1900, low socio-economic one but rich in historical and cultural heritage. It is considered an epic center of the city's archaeological heritage. It is associated with a number of distinctive cultural and historical events. The significance of Kom el Dikka goes to the presence of Sayed Darwish home which is an important inspiring factor to artists, with different social groups living such as those from Al Nuba, Upper Egypt, countryside as well as Alexandrians. Recently, there has been an increase in the population of Kom El Dikka due to increase in building units in the last years. It is divided into two parts East and West with a total population of 7736, population density 419 and total density 161 shown in Fig. 4.

4.2. Sense of community index (SCI)

A survey has been developed to test perceptions of sense of community were assessed through measuring the dependent variable (sense of community) / Independent variable (built Environment).

4.2.1. Measuring the dependent variable (sense of community)

It is fulfilled through a combined measure of sense of community index (SCI) the social and psychological factors of Kim and Kaplan theory. This section attempts to establish an understanding on the impact of cultural factors, social-spatial character, physical factors and their relationship with neighbors on sense of community.

4.2.2. Measuring the independent variables:

The built environment is measured through: an observation table of the physical attributes of the built environment. It

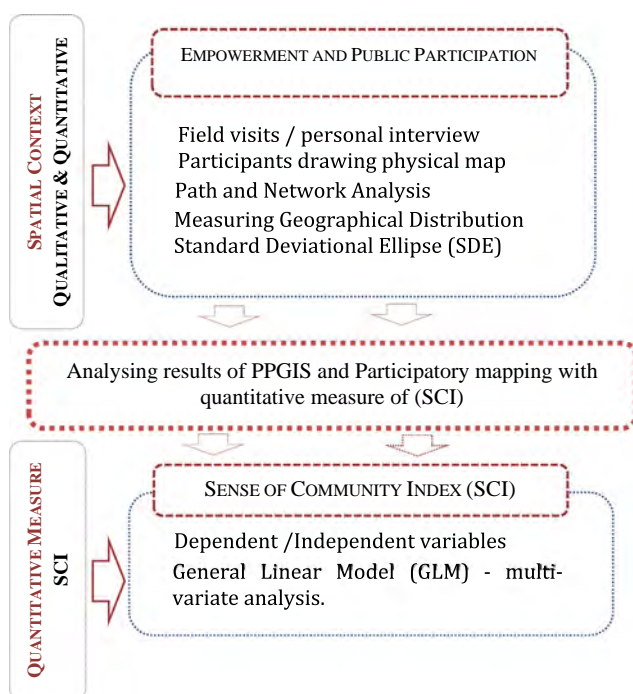


Fig. 1 Adopted Methodology.

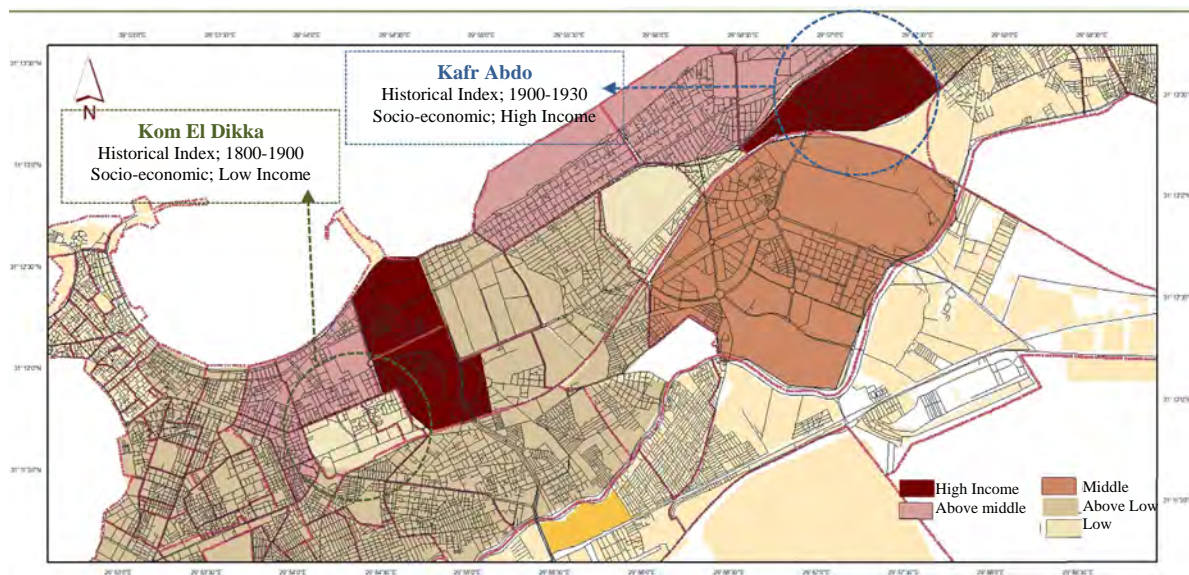


Fig. 2 (A) The administrative boundaries illustrating the, social economic conditions, historical background and the location of case studies.

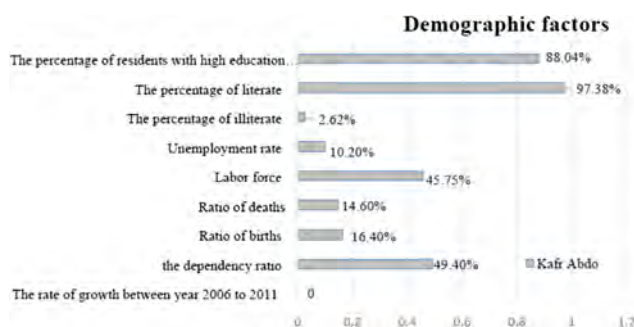


Fig. 3 Demographic factors of kafr Abdo.

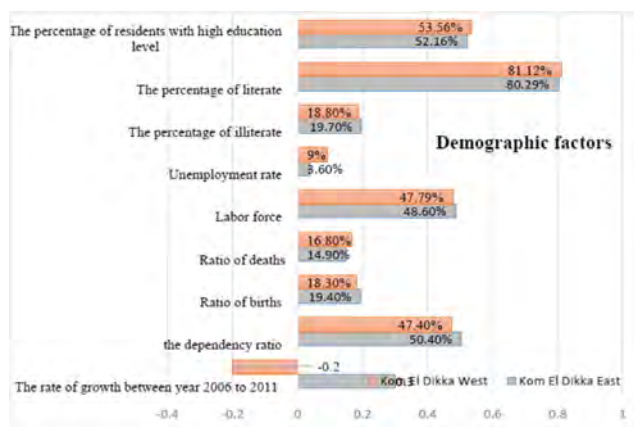


Fig. 4 Demographic factors of Kom El Dikka.

consists of physical factors suggested by Kim and Kaplan theory, as well as built environment variables (transport, safety and danger, privacy and crowding, participation and empowerment). Social economic conditions and (high economy or low economy) and the history of the neighborhood (new neigh-

borhood or old neighborhood): These two variables have been identified using quantitative data and statistical analysis. It is a Likert scale tool (bad or not exist = 1, fair = 2, good = 3). This observation is divided into three sections Aesthetics, streets and services and buildings.

4.2.3. Sample and data collection

A random sample of 112 participants from the two neighborhoods were selected based on the ©Launch Epi Info 7 software (minimum required sample was 50 participants).

Data were collected from both on-site/on-line surveys and interviews, conducted from June 29th, 2016 till July 29th, 2016, as shown in Fig. 5. The on-line survey used the Kwik Survey application (Kwiksurvey, 2016). It was shared through different websites such as: Facebook, Twitter and LinkedIn. It has been shared in two languages Arabic and English and it targeted different places and people in the selected neighborhoods. The sample included in the final analysis was total 112, kafr Abdo 75, Kom El Dikka 37 [23]. Regarding the small sample of the survey and it was solved using the “Monte Carlo exact probability”, it is a method used to compare competing statistics for small samples to give a realistic figure. The survey consisted of 30 questions and divided into 3 major sections as follow;

Section 1: General personal information

- It includes question regarding gender, age, the presence of children, ownership status, and level of education, employment status, income and length of residence.
- Objective of this part is knowing the influence of demographic factors on the respondent's sense of community to know their different ways of thinking.

Section 2: Evaluation sense of community

- It is divided into 3 parts, including the people's opinion about their social interaction within the community, their community attachment and identity and the physical

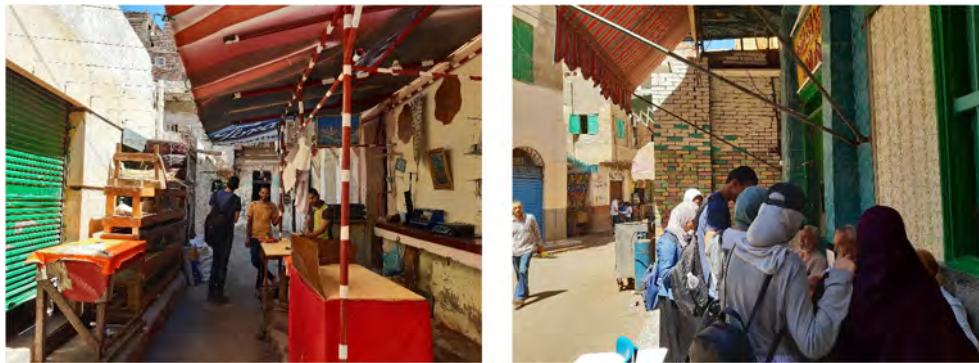


Fig. 5 During Conducting on-site survey targeting Different age groups.

factors of their community (Pedestrian). The responses answers are in the form of Likert scale (the five Likert scale varies from 1 to 5, as 1 = strongly disagree, to 5 = strongly agree.

- The targeted objective of this part is concluding the values of sense of community in different neighborhoods and comparing their results to know the impact of cultural factors, social-spatial character, physical factors and their relationship with neighbors on sense of community.

Section 3: General comments

- It includes general comments and thoughts of the survey's respondents.
- Objective of this part is concluding recommendations about sense of community, and to estimate the needs of residents towards their community in order to increase its sense of community.

The data has been analysed using SPSS version 18. First, a descriptive analysis of survey results has been done to identify percentage of sense of community in each neighborhood. Then, a General Linear Model (GLM) - multi-variate analysis - has been used to examine the association between sense of community and social economic conditions, history of the neighborhood and the built environment (physical attributes). This approach was adopted according to Giles-Corti [10]. Subsequently, the researchers identified the positive or negative relations between the physical observation and the result of survey. Finally, a descriptive analysis of significant variables resulting from the multi-variate analysis has been done to give more detailed results [24]. Therefore, using participatory mapping in Kom El Dikka, with the lowest score of sense of community Index, is crucial to understand the reasons behind Low sense of community through analysing the activities of users in order to deepen our understanding with the survey analysis.

4.3. Empowerment and public participation

This study combines the participatory mapping of activity space to examine the community experiences of 25 locals living in Kom El Dikka, these participants varies between males and females and different age groups. Participants were asked about their age, level of education, employment status, their perception toward neighborhood, access points, boundaries and their activities. Through documenting the activity spaces

in which locals participate, including the types of activities youth engage in and the geographic spread of activities. Then, investigating the relationships between activity participation sense of community and psychological well-being. It was hypothesized that both the total number of activities reported by participants and also the square-mile area of their activity spaces will be positively correlated with their psychological well-being and sense of community. This hypothesis is supported by research suggesting associations between activity participation, sense of community, and well-being among youth in the general population [25].

As part of the process of creating and examining the activity spaces, the activity locations reported by participants were coded into the following three categories;

- (a) Service activities (i.e., health service, religious services, markets, transportation hub).
- (b) Social activities (i.e., places such as restaurants, shops, or parks where youth go to hang out, recreate, and engage with social support networks).
- (c) Necessary activities (i.e., jobs, schools).

Regardless the small sample of participatory residents that were able to draw physical map as they were not used to express themselves in such way. Therefore, it is recommended a future study that should collect data from a larger number of individuals across more varied locations to increase both variability in results and for detecting relationships between different variables. Although, the results from all the participants who were encouraged to draw physical maps identifying the boundaries of their neighborhood and main access points, then locating their activity spaces and how they are conducted, walking or using public transportation system and the estimated time to reach their destination the participants tend to draw path and identify locations for where they move, as illustrated on Fig. 6(A,B). While other participants just identified locations of where they go and how they access the neighborhood and how they commute to work, especially for the one working outside neighborhood as illustrated in Fig. 7(A). the last group identified the most important path they use a lot with the locations they go, as shown in Fig. 7(B).

4.3.1. Identifying activities and access points

Then, the physical maps drawn by locals were established using GIS, First; the neighborhood boundaries drawn and the categorized activity spaces, participants identified a total

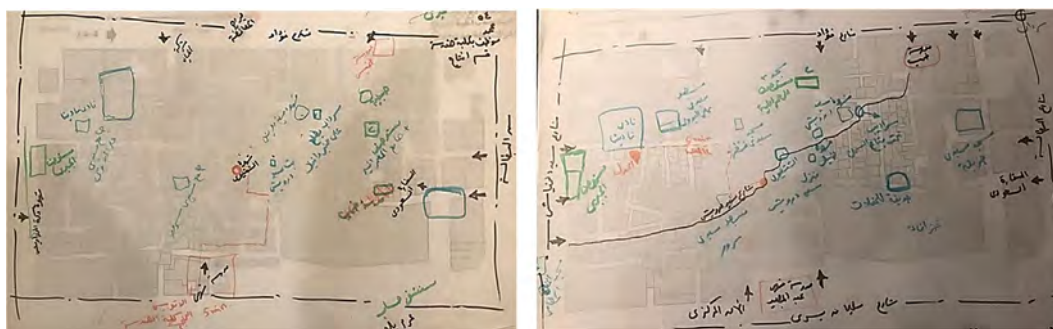


Fig. 6 (A), sample of drawn physical map for 17 years old male & (B) 35 years old household female.

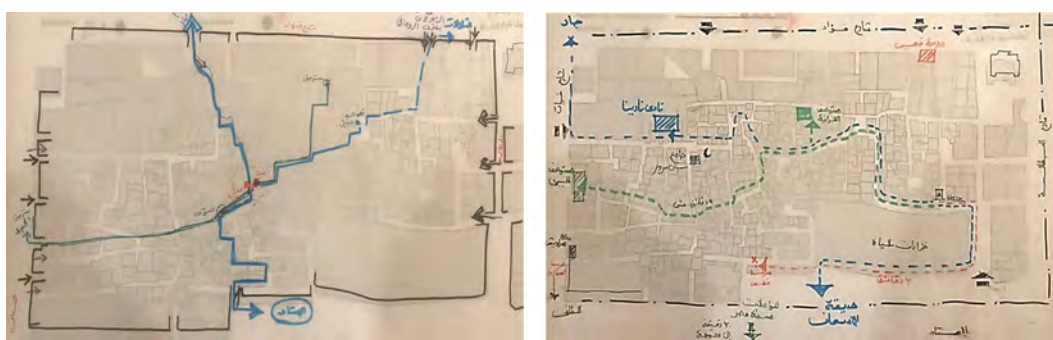


Fig. 7 (A), sample of drawn physical map for 54 years old working male & (B) for 25 years old working female.

number of 26 locations used as social activity, total number of 15 locations used as services activity and finally a total number of 16 locations used as necessary activities and access points identified on map, as shown in Fig. 8. All participants with different age group were able to identify the boundaries, the main access from all sides, even the important locations around their neighborhood. One of the main access points in Kom El Dikka from Fouad street, the neighborhood entrances with coloured stairs. Which is well known for all the visitors, where the children played a great role in the participation of development project of Kom El low to moderate Dikka because of the group of scouts that named “Class of discoverers team”. They participated with their chiefs and some assets from district “Waset” in the development of the neighborhood and founded Kom El Dikka Development Association which made a big difference in the neighborhood and prepared a lot of social events was not used a lot among residents, but the third entrance from Fouad street is the one used a lot by residents, as it is larger, and cleaner.

4.3.2. Path and network analysis

A Path and network Analysis were conducted to examine the time and the square meters needed for reaching locations from residents' home as shown in Fig. 9.

Path and network analysis are capable of measuring the geographical relationships of the spatial network; where distances, angles, and travel times are accurately calculated. It is a crucial method in describing adjacencies and proximities between places. First, the personal address of residents has been geocoding, then starting with creating zones of 200 m,

400 m and finally 800 m. These buffer zones were created in order to measure the distances of activities and measure their proximity to residents' homes. It was found that Services and social activities are located within 200 and 400 m from most of residents a walking distance providing them the service with an affordable price regardless the good quality of these services. Meanwhile, their necessary activities as primary schools located within 200, 400, while Secondary and high schools within 800 m and 1200 m, this also emphasizes high Community attachment and identity among age of 16 till 30. Their school, club, social gathering places are completely contained within neighborhood. Residents were asked if they participate in cultural activities held in the neighborhood. All of them identified “Dekat El Darwish” Café that held an annual celebration for sayed Darwish and it is located on the periphery of neighborhood facing the Greco- Roman Theater. For the necessary activities, Some of them are within 200, 400, 800 m for the people working in the neighborhood, but for the rest of citizens they need to commute, but most of them use the main train station near them it is within 800 m but commuting to work sometimes need 45 min plus the walking distance.

In order to compare the results from the statistical analysis with the spatial analysis, this is done through analysing the activity spaces according to their geographical distribution using the Standard Deviational Ellipse (SDE) method, The SDE is a statistical measure that provides a comparable estimate of the individuals' activity space. The importance of quantifying this figure is that it can then be compared to self-report survey data to uncover potentially meaningful

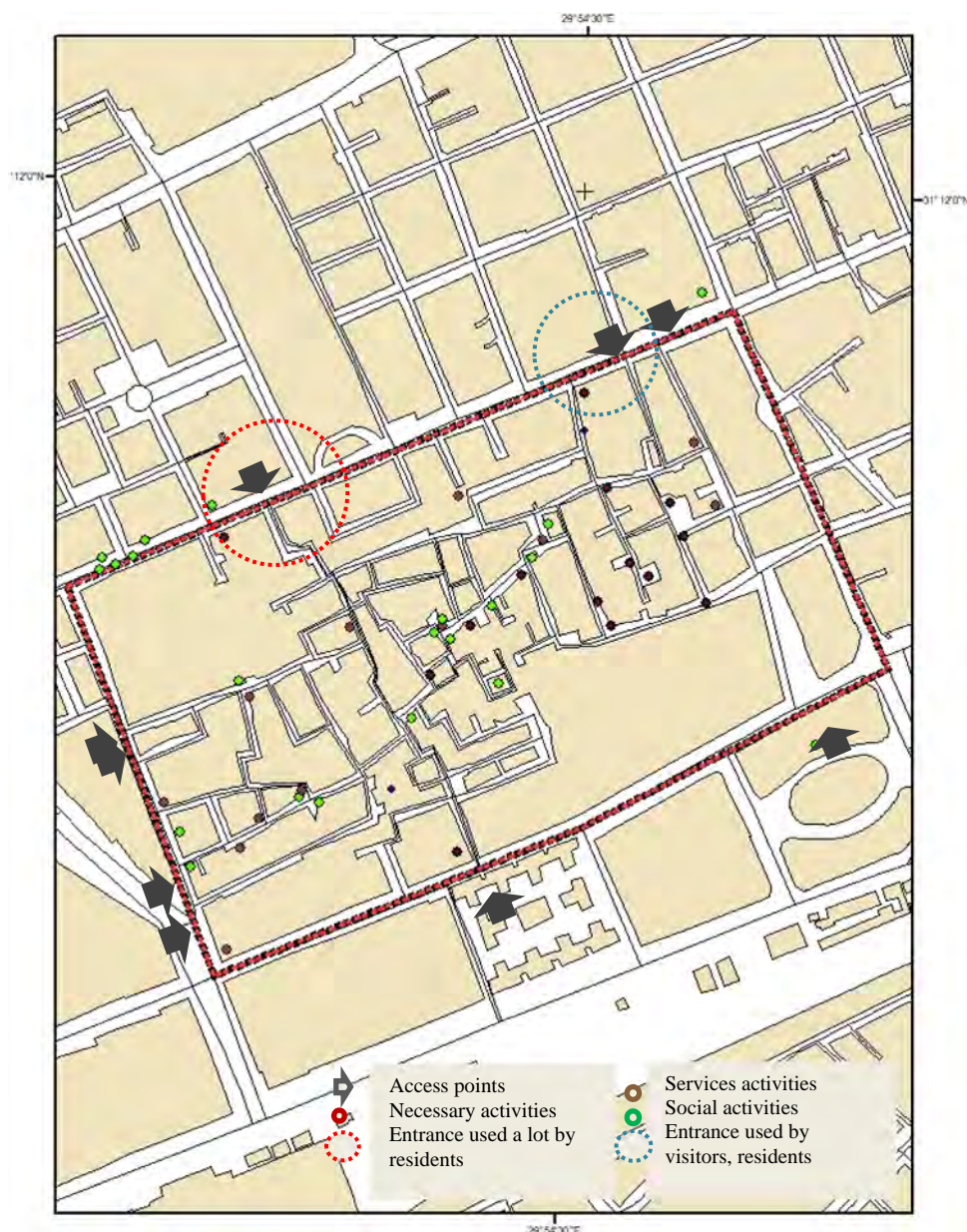


Fig. 8 Identified locations and access points.

relationships between psychosocial variables and the square-mile area of the activity space ellipse [23].

4.3.3. Measuring geographical distribution

Finally, all activity spaces were measured their geographical distribution using the Standard Deviation Ellipse (SDE) method, as shown in Fig. 10.

Using the designated points that were plotted for each participant, the SDE method calculates the standard deviation of the distances of the x coordinates and y coordinates of each individual point from the mean center of all points to define the major and minor axis of the ellipse. The activity space ellipse can be used as an indicator of individual access to or to identify the opportunity of movement throughout the community. Using SDE tool in GIS, is to calculate the distances of

each activity space that represents the geographic spread of community activities in which the individual reports engaging.

5. Results and discussion

This research is an attempt to assess the social and spatial experiences of local community, through adopting a methodology that combine the public participatory GIS tools (qualitative and quantitative attribute) to understand communities in better ways with the aid of statistical analysis (quantitative measures), comparing results of statistical survey with the PPGIS in order to help decision makers.

First, the statistical survey revealed that Kafr abdo has higher sense of community Index than in Kom El Dikka, it has a moderate sense of community 80.4%, while kom el

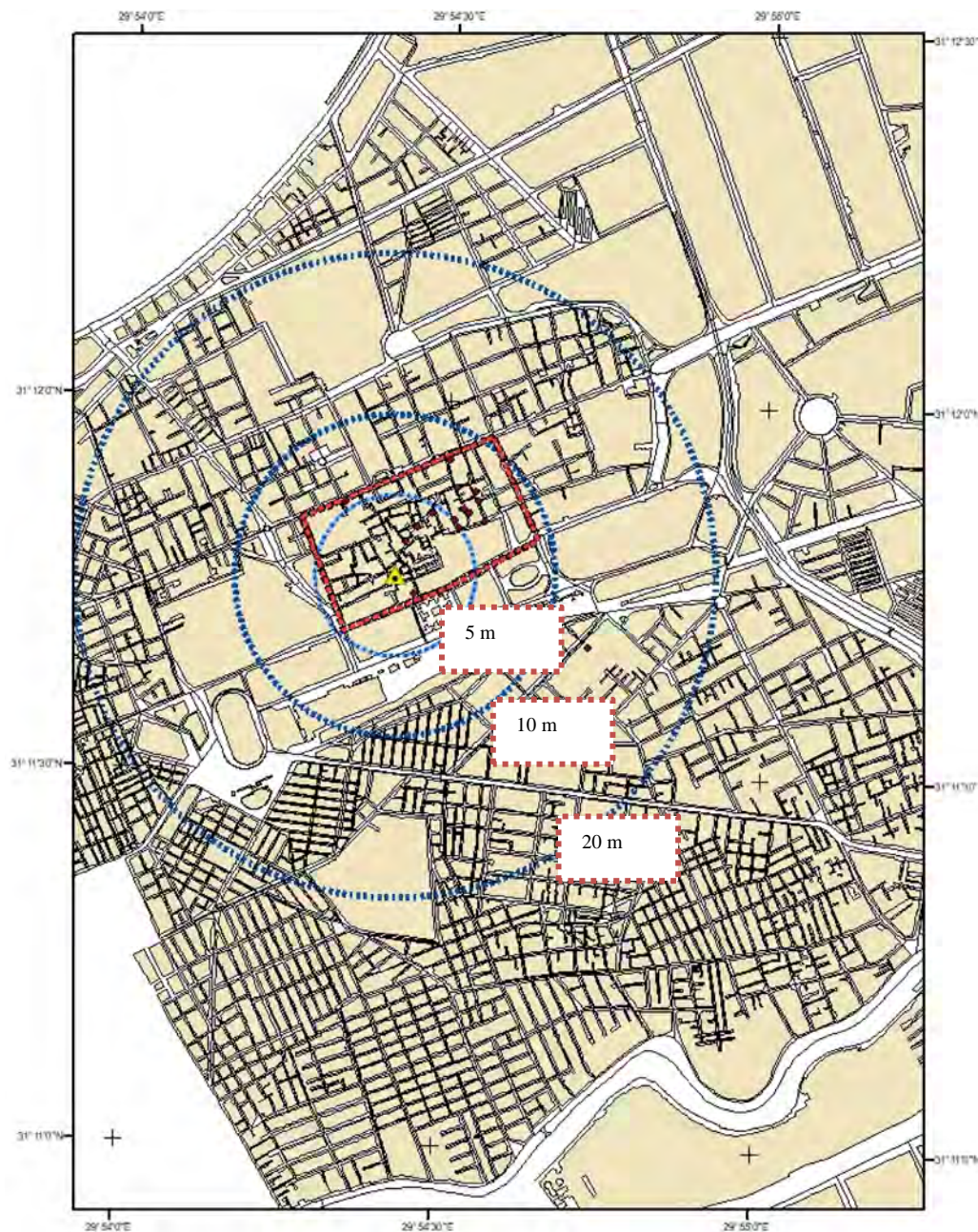


Fig. 9 Path and Network analysis.

Dikka has a low sense of community 47.6%. Concerning sense of community domains, community attachment and identity is the most effective in measuring sense of community, as it expresses ways in which one feels at home and belonging to the community, then pedestrian and finally social interaction. The results of sense of community Index in each neighborhood as shown in Fig. 11 are identified as follow:

Concerning the quality of the built environment in each neighborhood was measures individually; Kafr Abdo 89% has a higher quality of built environment than in Kom El Dikka 75%. The built environment in Kafr Abdo is high (68%) to moderate (32%). While in Kom El Dikka is moderate (59%) to high (37%). Then, the linear regression model showed that significance of each variable of built environment with sense of community is as follows according to the value of

β (standardized coefficient); Aesthetic, Streets and services and finally buildings. The three sections are significant with sense of community, their importance in descending order depending on the value of β are; street and services, aesthetics and finally buildings [24].

These results needed more elaboration as for kom El Dikka, it has a higher social interaction, but at the end it has the lower sense of community Index (SCI). In addition to that the correlation that has been done to examine the significance of each physical attribute with the sense of community Index (SCI). It was found that the majority of them are significant, but some physical attributes are not significant in this study such as the presence of uniqueness and local characteristics, mixed use neighborhood, community services and population density. Concerning the spearman coefficient's sign

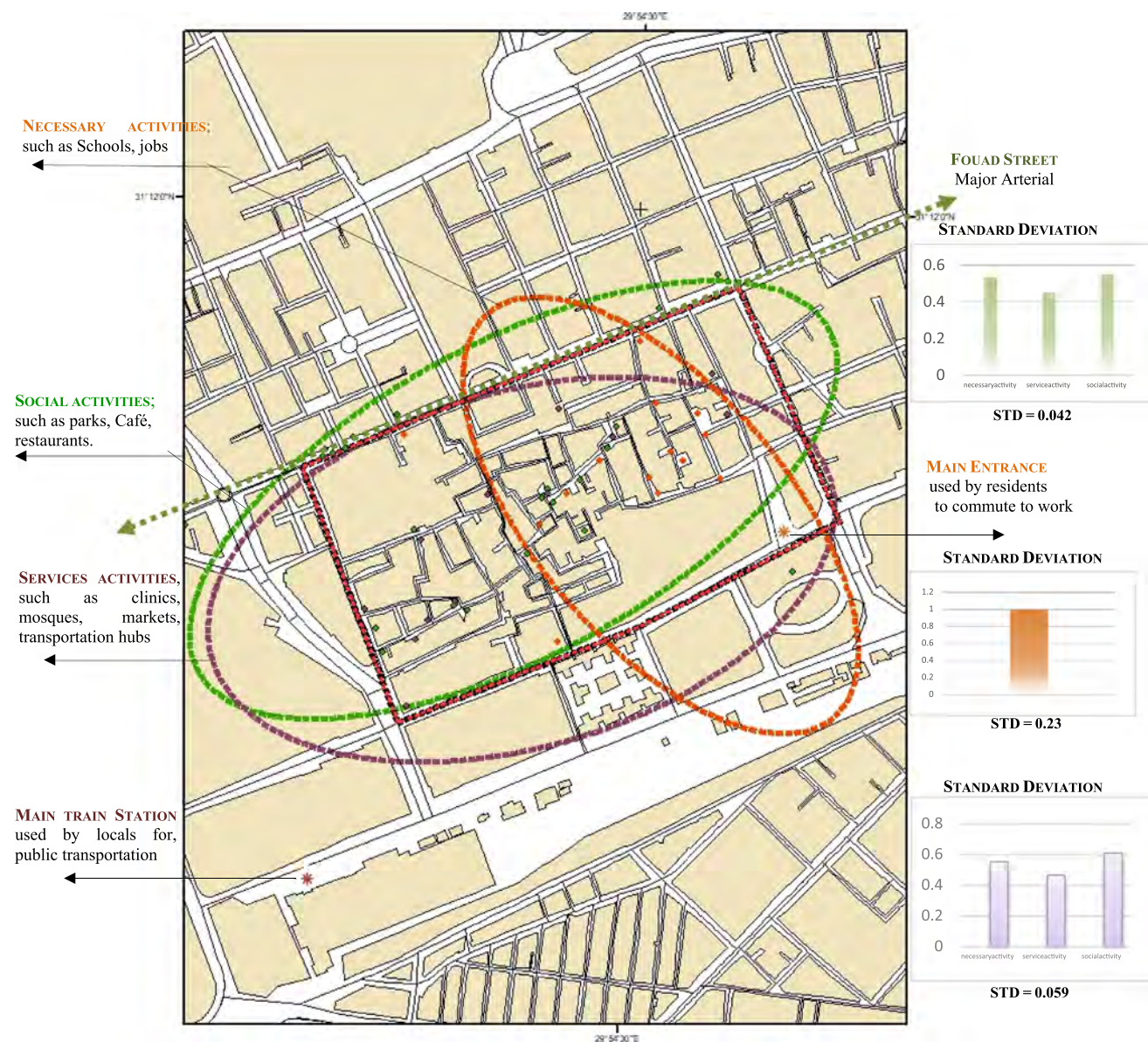


Fig. 10 The Standard Deviation Ellipse (SDE) for the activities.

(it indicates the type of relationship), there are a negative relationship between sense of community and some significant physical attributes such as the presence of major attraction

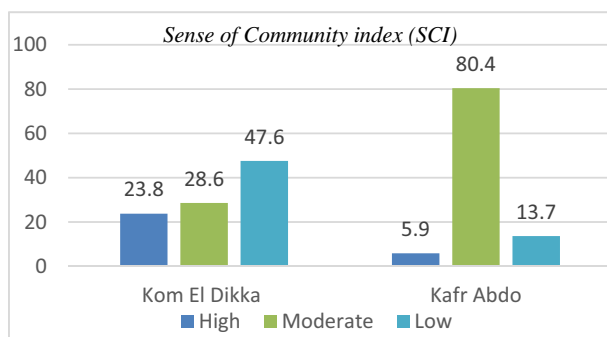


Fig. 11 Comparison between sense of Community index (SCI) between neighborhoods.

in the community layout and design, the architecture style is well connected to the past and parking facilities and public transportation [24].

The public participatory GIS maps reveals important facts and explaining the following concerning Social Interaction; the analysis showed that local communities engage in a variety of activities in their neighborhood. As, all participants with different age group were able to identify the boundaries, the main access from all sides, even the important locations around their neighborhood. One of the main access points in Kom El Dikka from Fouad street, the neighborhood entrances with coloured stairs. Which is well known for all the visitors, where the children played a great role in the participation of development project of Kom El low to moderate Dikka. They participated with their chiefs and some assets from district "Waset" in the development of the neighborhood and founded Kom El Dikka Development Association which made a big difference in the neighborhood and prepared a lot of social

events was not used a lot among residents. Although this entrance created high participation level between residents, this matches the high social interaction in the statistical method. Meanwhile, the third entrance from Fouad street is the one used a lot by residents, as it is larger, and cleaner.

Concerning the community attachment, PPGIS identified that the residents with age 16 to 30 have the highest level of community attachment, most of residents at that age attached to their community, as most of activities needed are within walking distance of neighborhood. On the other hand, there is low percentage in the community attachment and identity between age 30 till 60 years old. residents complain from long commuting hours to reach work, deteriorated situation of the whole neighborhood. The economic condition are unstable, high prices being paid for the electricity and water bills. Area is losing its identity as a cultural zone especially home of the well-known artist "Sayed Darwish. which reflects the insignificance of unique and local characteristics in sense of community index (SCI), as no one goes to its home as it is demolished now, thus, the Uniqueness (the unique character of the neighborhood) is being neglected. The percentage of pedestrian is moderate to low in Kom El Dikka, although all their necessary, social and services activities within walking distances but the neighborhood suffers from bad condition in streets, sidewalks and aesthetics aspects. This matches the results of survey when analyzing the Sense of community index (SCI) with the built environment in order to analyze how built environment effect participants sense of community.

Analyzing the map of Standard deviational ellipse of location of activities in Fig. 10; it is obvious that activity locations, particularly Social activities, tend to be clustered in middle of neighborhood especially in the main spine of kom el dikka, and on the periphery whether from Fouad street or from Greek Roman theater, it has an average standard deviation ($STD = 0.042$), this means that all the points are within the range of neighborhood. The social activities of the middle age of locals engaged in, are very well established and achieved their self-satisfaction and this can clearly explain the high results of Community attachment and identity from the statistical survey (quantitative studies). While the service activities like clinics are totally containment in the neighborhood as it is the cheapest services they can have, although it is not the best and mosques are close to their homes, nearest church is within 1 kilo, and also, the transportation hub as Main train station is the main station they are using to commute from neighborhood to another place. It is very obvious that the service location is more attached to the center of neighborhood and its southern hinter with an average standard deviation ($STD = 0.059$). For the necessary activity it is located in the eastern part of neighborhood, in addition to that, it is very obvious that the locations are maldistributed with an average standard deviation ($STD = 0.23$) where there is two main primary schools, and vocational wood workshops owned by residents of neighborhood, other residents they go to the Main train station or they use the access towards the stadium to commute to work and minimum time estimated to reach work is 45 min. Which in turn reflect the results of low sense of community attachment towards the age group from 30 till 60 years old, as they are less attached to their neighborhood suffering from the negative impacts of built environment they are living there.

The statistical analysis showed negative relationship between sense of community and some significant physical attributes such as the presence of major attraction in the community layout and design, the architecture style is well connected to the past, which seems to be effective in Kom El Dikka neighborhood that used to had a special character, it is associated with a number of distinctive cultural and historical events. This neighborhood has some major attractions such as: Sayed Darwish history and Sayed Darwish House but nowadays, it suffers from the following; the streets and services are not in a good condition. The negligence of this important space by the local authorities in Alexandria to the extent that there is not even a single sign to even indicate the neighborhood of Sayed Darwish, all these factors cause a low sense of community attachment and community identity between residents as it was mentioned by all of them. Even, in Kafr Abdo although it has some advantage such as, aesthetics pleasantness, walkable streets with good sign system and the presence of squares and green areas, respect towards buildings lines, windows proportions and harmony. But the neighborhood had a moderate community attachment and community identity due to losing its unique character because of the destruction of historical villas and the construction of new high-rise buildings that do not respect the human scale.

Therefore, the local character of the neighborhood, destruction of historical buildings and aggression on shared place have significance in affecting the community attachment and identity. At the End, this method allows the participants to illustrate, and discuss areas in their communities where they spend time, achieve a sense of belonging, and participate in activities considered to be important. Therefore, it is recommended that the decisions makers should encourage the empowerment and the public participation in decision making. As, it helps in decision making to comprehend the existing situation from a social and spatial point of view.

6. Conclusion

This research is an attempt to assess the social and spatial experiences of local community it aims at investigating the relationship between local community activities, their perception of built environment and their sense of community, through using Public Participatory GIS, as it is an effective tool that provides spatial complexity, spatial context, interactivity and interconnection in the articulation of context and capable of deepening our understanding of quantitative measures. To achieve that, a methodology is adopted employing participatory mapping and Geographic Information Systems (GIS) to examine the activities of locals in the neighbourhood with lowest score of sense of community index resulting from a quantitative survey formed of sense of community index (SCI), applied on two neighbourhoods in Alexandria city, Egypt. The participatory mapping and GIS methods is utilized in this study to expand our understanding how locals perceive their neighborhood and how they engage in a variety of activities in their neighborhood.

This interactive participatory approach is capable of capturing the richness of persons' experiences. In addition to that, it is more "accessible" and engaging to individuals who are not accustomed to translating their experiences into scale scores. Creating maps can also provide individuals with an

empowering sense of competency and authority. As, the residents are the experts of their own experiences in the community, and this method help in understanding and measuring these experiences accurately and appropriately. The PPGIS revealed that the low sense of community in Kom El Dikka neighborhood although it has a special character and cultural history is suffering from losing identity and uniqueness of place, bad condition of streets and services, the residents are classified in their priority according to age groups the one from 16 to 30 more attached to Fouad street and the northern part of neighborhood and satisfied with activities and services provided, the age group from 30 to 60 are unstable economically, loaded with long commuting hours to reach their job, dissatisfied with the demolished house of "Sayed Darwish" total negligence of this important neighborhood to an extent that there is not even a single sign to even indicate that it is the neighborhood of Sayed Darwish, the loss of its unique character, which shows that the local and unique character had a positive significance in indicating the sense of community which is different from the result showed from statistics. All of the mentioned factors lead to the low sense of community among residents.

It is very important to always depend on quantitative and qualitative measures cause both of them give a complete figure about the existing problem and how to interfere to solve the problem, so it is a very good tool in decision making. Participatory Public GIS mapping When paired with Quantitative measure, act as indices of person–environment interaction by allowing for the geospatial representation for the types of activities of the local engage in. It was found a very useful tool to inform targets of intervention and goal setting. Kom el Dikka Neighborhood needs attention by the local authorities in Alexandria to the retrieve the cultural and historical aspect of this place. Enhancing its built environment and providing good and adequate services to locals, therefore, it is recommended that the decisions makers should encourage the empowerment and the public participation in decision making, in order to involve citizens in the developing process and enhancing quality of life thus increase sense of community towards their city.

Declaration of Competing Interest

I declare that the research doesn't have any conflict of interest with any parties.

References

- [1] UNESCO moving forward the 2030 Agenda for Sustainable Development, 2019. <https://unesdoc.unesco.org/>.
- [2] J.L. Nasar, D.A. Julian, The psychological sense of community in the neighborhood, *J. American Planning Assoc.* 61 (2) (1995) 178–184.
- [3] J.L. Nasar, Does Neotraditional Development Build Community?, *J. Plan. Educat. Res.* 23 (1) (2003) 58–68.
- [4] J. Francis, B. Giles-Corti, L. Wood, M. Knuiman, Creating sense of community: the role of public space, *J. Environ. Psychol.* 32 (4) (2012) 401–409.
- [5] Schweitzer, J., 1996. A description of sense of Community in Lansing Neighbourhoods' Project. University of Michigan: presented at the "Defining Community, Reinforcing Society" conference.
- [6] CAPMAS, 2016. Statistical year book, Cairo: Central Agency For Public Mobilization and Statistics.
- [7] UNDP, 2010. State of the built environment and housing indicators of seven Egyptian cities, Cairo, Egypt: comprehensive report.
- [8] G. Pretty, B. Bishop, A. Fisher, C. Sonn, Psychological sense of community and its relevance to well-being and everyday life, in: Australia, The Australian Psychological Society Ltd., Australia, 2006.
- [9] D. Chavis, J. Hogge, D. McMillan, A. Wandersman, Sense of community through Brunswik's lens: a first look, *J. Community Psychol. Issue Theory* 14 (1986) 24–40.
- [10] L. Wood, L.D. Frank, B. Giles-Corti, Sense of community and its relationship with walking and neighborhood design2, *Social Sci. Med. Elsevier Ltd.* 70 (2010) 1381–1390.
- [11] L. Berkowitz, Group norms under bomber crews: Patterns of perceived crew attitudes, and crew liking related to air crew effectiveness of Far Eastern combat, *Sociometry* 19 (1956) 141–153.
- [12] J. Kim, R. Kaplen, Physical and psychological factors in sense of community, in: New Urbanist Kentlands and Nearby Orchard Village, Environment and Behavior, 2004, pp. 314–340.
- [13] W.B. Davidson, P.R. Cotter, Measurement of sense of community within the sphere of city, *J. Appl. Soc. Psychol.* 16 (7) (1986) 608–619.
- [14] J. Zaff, A.S. Devlin, Sense of community in housing for the elderly, *J. Community Psychol.* 26 (1998) 381–398.
- [15] D. Aberley, Boundaries of home: Mapping for local empowerment, Gabriola Island, BC: New Society, 1993.
- [16] B. Parker, Constructing community through maps? Power and praxis in community mapping, *Professional Geographer* 58 (2006) 470–484.
- [17] G. Townley, B. Kloos, P.A. Wright, Understanding the experience of place: Expanding methods to conceptualize and measure community integration of persons with serious mental illness, *Health Place* 15 (2009) 520–531.
- [18] C.J. Coulton, J. Korbin, T. Chan, M. Su, Mapping residents' perceptions of neighborhood boundaries: A methodological note, *Am. J. Community Psychol.* 29 (2001) 371–383.
- [19] K. Lynch, The image of the city, MIT Press, Cambridge, MA, 1960.
- [20] R.E. Sieber, Public Participation Geographic Information Systems: A literature review, *Ann. Assoc. Am. Geogr.* 96 (3) (2006) 491–507.
- [21] Czepkiewicz, M., Snabb, K., 2013. 'LEAN' Public Participation GIS: Towards a Sustainable Tool for Participatory Urban Planning. Geoinformatics for City Transformation, January 21 – 23, Ostrava
- [22] E. Talen, Bottom-up GIS: A new tool for individual and group expression in participatory planning, *J. American Planning Assoc.* 66 (3) (2000) 279–294.
- [23] Ashraf, P., 2017, Sense of community and Built environment: How can built environment, social economic conditions and history of place shape our sense of community?
- [24] P. Ashraf, H. Ayad, D. Saadallah, Sense of community and built environment: how can built environment, social economic conditions and history of place shape our sense of community, *Int. J. Eng. Adv. Technol. (IJEAT)* 6 (3) (2017) 2249–8958.
- [25] G. Townley, L. Pearson, J. Lehrwyn, N. Prophet, M. Trauernicht, Utilizing participatory mapping and GIS to examine the activity spaces of homeless youth, *Am. J. Community Psychol.* 57 (2016) 404–414.