Technological Advancement in Mapping of Heritage by Using GIS (Mapping of Heritage: Preservation for the Future)

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Abstract— **Lahore the historic city is expanding day by day. The urban expansion affected the heritage boundaries, results into shrinking and deteriorating the precious structures. The study aims to map the historic sites by looking into it the impacts of urban development through boundary delineation process. The pictorial journey elaborates how the precious heritage are being packed into haphazard containers of irregular boundaries, which vanished the beautiful impacts of Mughal gardens around the historic structures helplessly standing there to feel pity in them. In order to improve the effectiveness of preservation strategies the role of new digital technologies such as GIS has played their vital role in the building conservation strategies. This paper presents the results of a research developed as part of the research project conducted by the researcher in college of Art & Design, School of Architecture, University of the Punjab, Lahore, Pakistan. The aims of the study were to explore the implementation of GIS as a conservational specialist in the field of conservational management, to deal the various aspects facing while managing the Mughal sites widely spreading the study area in the 3-D environment and using the GIS analytical tools to determine the urban development impacts on historic buildings. This study fills the gap between the CAD and three dimensional environment and integrating GIS from scanned images of heritage sites or photogrammetric data to the library of parametric architectural objects of the historic buildings and represent in the form of overlay layers. A framework of modeling, 3D geometry, topology, semantic, appearance properties, efficient management and analysis of the relevant data to the heritage sites are used in the research.**

Key Words: **GIS, Heritage, Conservation, Urban Development**

I. INTRODUCTION

Built heritage consists of all aspects of the manmade historic environment such as houses, factories, and commercial buildings, places of worship, cemeteries, and monuments and built infrastructure such as roads, railways and bridges; physically created places such as gardens, mining sites and stock routes; and other places of historical significance such as archaeological sites.

These lists are not exclusive, and built heritage is defined and categorizes according to the need and values of the person or groups making the definition. Built heritage can be of importance to any one person, group, community, nation or group of nations. There is sometimes agreement in the value of built heritage among many persons or groups, but sometimes values are not shared, and may even be contested.

More advanced definition of heritage has allowed built heritage of the Modern Era to be recognized for its historic and cultural value. Built heritage of the Modern Era encompasses all types of constructions between 1930 and the mid-1970s. However, built heritage of the Modern Era is often undervalued by the general public and many remarkable buildings built before World War II or immediately after do not appear on official heritage lists.

Our built heritage, as the physical evidence of our cultural development, is one of our most important cultural assets. Built heritage helps us to understand where we have come from and who we are today. It allows us to maintain a link with the past, defining a sense of place and identity for communities, both urban and regional.

Built heritage is not only buildings and monuments of exceptional value but also includes small modest vernacular buildings that embody other equally important historical, social or even archaeological values rendering them just as significant.

The significance of heritage places can change over time as community values evolve. Conservation does not require them to be preserved in their original condition or use, only that any alteration or development for contemporary use and enjoyment retains its original heritage features. In addition to regular maintenance, conservation may include preservation, restoration, reconstruction, adaptation and interpretation.

It is essential to conserve significant buildings that promote identity and continuity of place, without impeding development, which meets the current needs of communities. It is important to remember that the most significant elements of this modern layer of development will eventually form part of

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the built heritage of future generations. In present, the generation of 3D cultural heritage models has become an interesting subject. The previous survey methods do not provide the facility to record the details of historic buildings on site. The GIS technologies have made it possible to record complex structures and sites accurately and efficiently with the exact latitudinal and longitudinal positions, which were not possible with the earlier survey methods. These GIS are evolving for the multi-layered formation for presentation, analysis, heritage archival documentation and visualization.

The developing countries are moving towards fast urbanization trends as it is worldwide accepted that fast urbanization growth is most important spectacle worldwide causing serious threat to the environment[1].According to the United Nation's statistics the world population is going to be change up-to 8.3 to 9.1 billion by 2030 and 2050 respectively[3]. Studies show that urbanization happen when people move from rural areas to urban areas to seek economic opportunities and to improve their standard of living. As rural life is not able to meet their all requirements of life and the city or urban life is appropriate to meet their easy access to wealth [8] .Urbanization is an unprecedented social and economic phenomenon taking place worldwide at a greater pace and scale [9].

Information about unplanned settlement is unavailable and the prominent land-use change is residential [1]. Characterization of urban expansion process is critically important [10]. The unplanned haphazard urban development results into serious health, environmental and social issues in urban areas[3]. The availability of remote sensing data from the last two decades has proved its scientific significance in order to detect the urban sprawl and land use, land cover change and mapping source over a time. [7]. Now a days remote sensing techniques are extremely beneficial for detecting urban sprawl in a significant and scientific manner [5] . The results obtained from the remote sensing data must be transferred to ArcGIS environment and multiple layer. Temporal analysis can be done. In this study, the remote sensing data of the Lahore city is being used in the historic district of Shalamar town. Multiple temporal layers are generated and the analysis shows that there is a significant change in the historic buildings boundary areas. This paper possesses a qualitative method to study the urban agglomeration in a specific historic urban center and allow the spatial pattern characterization study the urban land use change over a passage of time [6]. The GIS technology can be used as a tool in the conservation process in these modern days.

Pakistan not only contains the Antiquity act 1971 for the historic sites and monument protection but also follow the ICOMOS charter. It not only guide us to safe these precious structures from the intrusions of urban development but also brief us for the conservation policy making and social development strategy of urban & regional planning [2]. A historic building reveals about the people and culture that produced it, having impacts upon its historical and cultural identity being facing its survival to identity from hundreds of years can be claimed as being historic3.

The process of defining and identifying the outer edge of any building and area is called boundary delineation, and the tools and programs those may be imposed by the local communities and owners to encourage and implement the preservation and conservation of historic sites And the Conservation is the action taken to prevent decay. [4]

A historic district site is a formally designated building, structure, sites or a group of buildings that relate to one another historically, architecturally, and/or culturally. It can be a full neighborhood or a part of it. It can represent any architectural style; it can include any landscape or streetscape elements. Cohesiveness, Uniqueness, Architectural integrity is the main characteristics of any historic center. Each locality has its own objectives of preserving the landmarks and preservation sites.

Most of the historic buildings in a historic center or a district may be very simple [4] but in case of the selected site the selected historic buildings are of esteem importance and rich in Mughal architecture and building style. Their visual value, value of continuity and integrity contribute to townscape and its inhabitants and it creates a rich feeling of belonging, continuity and identity as well4. [4] The structures of these buildings contain information about historical and archaeological morphology. Conservation plan of these types of buildings need special care and attention by professional conservation architect.

The texture, material, visual effects and intrusion should be according to the visual effects of the historic buildings of the historic district. The respective authorities should maintain identity of any heritage structure in any historic city.

II. MATERIALS AND METHOD

In order to select the study area for the analysis and prioritize the site, there is a need to select and identify the position of the historic site for the formal geographic boundary delineation of the study area. In order to continue this process there are three main points: Limiting the size, Selecting a general location, Delineating specific boundaries. The extent of the entire existing area along the G.T road Lahore is very large, the number of compelling factors to converge towards a smaller study area where prestigious Mughal monuments and conservation sites present are numerous.

There was a need to focus the study area at

- manageable scale
- Within time
- Within appropriate resources

Data collection techniques, ground-truthing, old photographs and extending boundary delineation process by individual land parcels were much more labor intensive and time consuming. When the area and size of the study area is limited there is a need to determine the general and specific location of the site. The selection of the GIS environment is a better strategy to be used. The historic sites of known historic

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importance and near the main road as easily approachable were selected for the analysis.

Once the general boundaries of the specific study area were selected, it was required to determine the exact geographic boundaries of the selected sites. There were numerous ways to delineate the boundaries along the selected areas depending upon the existing location, existing condition, level of urbanization and urban development of course. It is need of the time to protect the monuments; structures and buildings of esteem historic importance so that we may recall our memories of prestigious past and secure the architecture style, culture and values to our future generations.

In order to establish record available data, old record, Photo‘s analysis for the defined parcel time and resource consideration is required and to complete the following delineation process of the selected site we have to consider the above three factors. 5When we rehabilitate, restore and maintain the historic buildings, it may enhance the sense of participation and community involvement, cohesiveness, civic pride reduce crime and increase safety. Greater sense of relatedness, more smart and active use of related materials and building structures

6.Rehabilitation is the procedure of a property to recurring back in the form of utilization, by repairing and amendments for efficient and up-to-date use of the historic asset even though conserving the substantial features which are part of historic, architectural and cultural value. [4]

There are few examples of building management information systems for the management of historic building conservation and restoration processes and laser scan survey data. There is a need to have information related to the architectural terminologies and nature of work. Georeference image is down load with real world geographic coordinates. Shape files are made in Arc catalogue with point, line and polygon features. All the scanned images photographs and material specification with relevant to each wall are stored in Arc catalogue and Arc Map. The 2-D images and plans are mapped in Auto cad also can be transferred to Arc Map into different shape file but bearing the same coordinates as on the actual earth surface. The three dimensional model prepared in 3-D AutoCAD or sketch up soft wares can bring into the contact with same geographic locations and overlay having the existing location and condition of the building and make original specification with the library specifications in Arc Catalogue .

The area of parametric modeling of architectural heritage building has initiated a new dimension of how architectural heritage structures and their models have differences in approach. The library formed along with pictures of historical data are combine together in building the models and mapping the objects onto point data and image with same lat long and survey data with architectural rules and photogrammetric procedures can be used to analyze the historic data and parametric designs and models. By the end manually refinement of the built models is done. Library and location specification and boundary demarcation in the form of polygon formation is made manually.

For the boundary delineation of historic buildings, the images were downloaded from the Google earth pro of different years. The images from Google earth at maximum resolution were downloaded. 7The images with the interval of five year have been downloaded but in some cases due to poor resolution and non-availability of image, the interval has changed to meet the objectives. Mostly the images of 2000, 2005, 2010 and 2015 were downloaded.

After performing image rectification the boundary demarcation have done based on personnel observation. The boundaries of different years have been digitized using Arc GIS and stored in the form of shape files.

The changes which occurred during different time period and are recognized as the changes in spatial properties from time to time is called temporal change and the process followed to determine this temporal change is called temporal analysis. Movement type of temporal analysis is used to determine the impact of urban development on the selected historic building in Lahore. Movement is the travel of an entity or an event from one spatial distance to another or it may or may not implicate spatial properties other than location.

With the passage of time due to rapid urbanization, historic places have been demolished or replaced by other societies or houses etc. In this research, it has been observed that with the passage of time the historic places have been reduced in their areas. As shown in the old pictures from the year 1929 of Jani khan tomb depicting the area around the tomb have enough open area around the mausoleum which have been reduced with the passage of time as shown in the pictures of the years 1930, 1965 and the year 2001. The temporal analysis has performed on the historic buildings by obtaining the satellite images with the five years intervals and by drawing their boundaries.

Multiple maps or images when super impose to make a composite with a common coordinate system in a GIS operation is called overlay. Boundaries of historic places of different years overlaid on each other containing the same spatial reference result into the detection of changes occurred during different time. This analysis helps us in understanding how the area of a particular historic place decreases with the passage of time. After performing overlay analysis, by comparing the recent year boundary and the oldest boundary i.e. the boundary of year 2000 in most of cases encroached areas have identified and mapped.

Final output maps have been generated which are showing the change in boundaries with the passage of time and encroached areas. This is the need of the hour to adopt conservation strategies to encourage historic communities to identified and map the visual qualities.

As the 3-D model and the multi- layer additional information can be improved and add-on by editing the xml files & adding the required attributes. In order to apply the GIS

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data storage techniques for heritage applications, the attribute of any historical area with the year of construction, restoration and the year of demolition can be useful for the chronological documentation of the whole area or some parts of the particular historic area to be stored are very useful. This will enable us to record the heritage change over time. This will also allow us to link the external resources in the form of Html, websites or other databases.

The existing records of heritage sites are linked with 3D. The details are shown in the maps generated as an example of Jani Khan Tomb. The high resolution photogrammetry allow us to view the old pictures visible and recordable from the year 1936 to up-till now in field of heritage documentation. It allow us to automate the documentation such as plan, elevation, sections and three dimensional model can be integrated into GIS platform for managing the documentation efficiently and proper analysis of heritage sites. The historic sites within selected area are gone through the buffer analysis showing whether the effect of road development are with- in the prescribed distance of 200 feet or not. Similarly the environmental pollution effects on the historic buildings can be measured by using stress maps and concentration of different pollutants can be determined through which we can estimate the damage being caused with the specific pollutants on the heritage structures.

III. CONCLUSIONS & RECOMMENDATIONS

- Integrate aesthetics into enactment procedures for planning, siting and construction of all new development and redevelopment works and create complete community conservation policy, which preserve the existing structures, restrict demolition, and damaging during construction and over the years to development, add new restoration policies to replace those lost over.
- There should be proper platform which provide information in building the gap between knowledge and practical implementation of the technological advancement in historic building management systems and their practical usage
- With the advancement in GIS technology there is the ease in implementation and usage of these technologies in preserving the heritage.
- A balance regulatory approach to protect historic resources including rewarding and stewardship by property owners, local governments and cooperation and given that disincentives for practices that destroy visual values of the historic structures should be encouraged.
- There should be proper tax incentives and property tax relief for conservation policy and good land stewardship.
- Those who break the law by making visual pollution should be fined, for those who use the visual environment for commercial advertising for true evaluation of their assets and imposing fees for uncompensated use of the roadways to cover the cost of services and access to the publically right of way.
- We should design a national conservation strategy that respects the historic values, economic efficiency, social equity and environmental qualities. Flexibility in road design standards, construction and reconstruction should be in bridge with excellence to respect scenic, community values, historic, natural landscape to incorporate natives and reflect themes of culture and local history.
- Young people should be taught to value the heritage and to create respect for historic places.
- Incorporate heritage conservation into all elementary and secondary education curricula.
- Incorporate the values of historic conservation into graduate courses in economics, planning, design and public policy and conservation strategy.
- In school, learning programs and scouting projects conservation projects should be included with the syllabus.
- Industry, business, civic and professional organizations should be actively engaged in the movement for a more historic Lahore.
- Heritage, recreational, cultural, tourism development, business and social organizations should be linked properly.
- Retired professionals should be enlisted in order to get benefit from their skills and political clout for the conservation strategy and policy making.

A. Figures and Tables

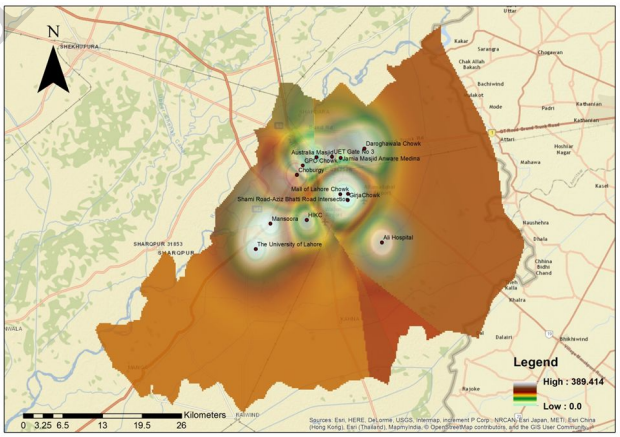


Figure 1.

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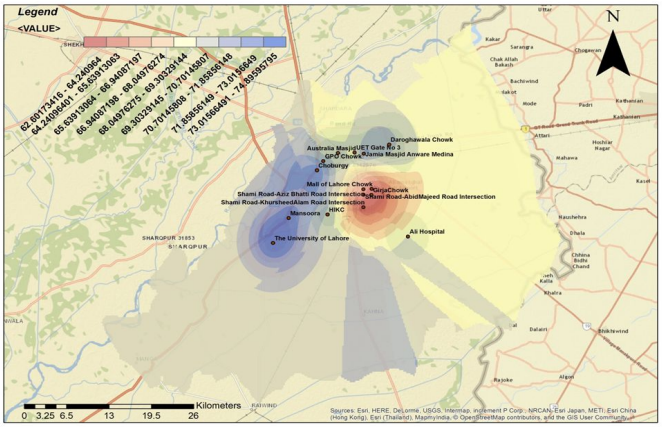


Figure 2.

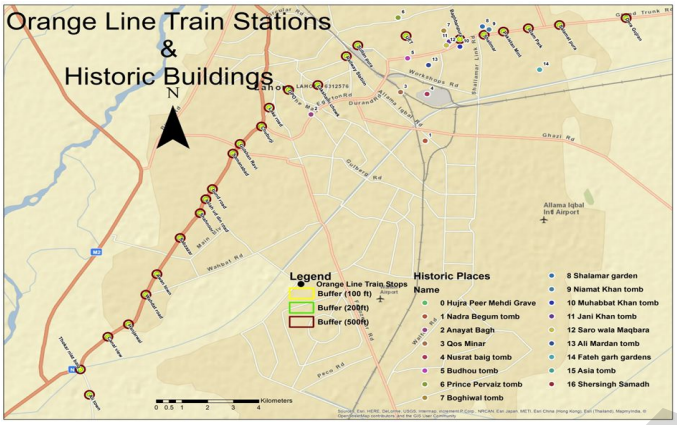


Figure 3.

JANI KHAN TOMB



Figure 4.

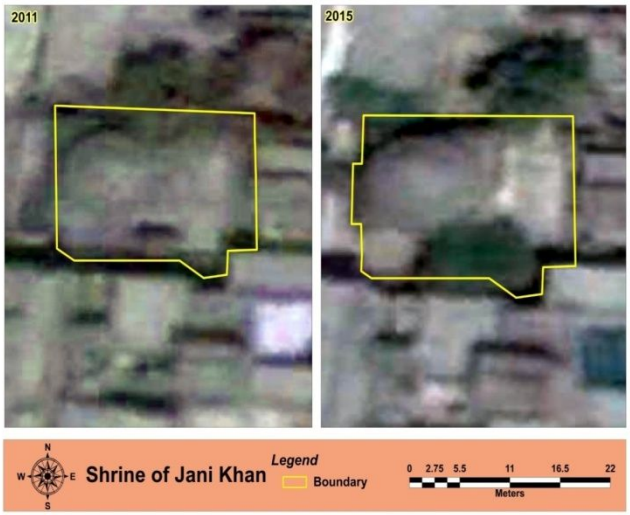


Figure 5.



Figure 6.



Figure 7.

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B. Abbreviations and Acronyms

ICOMOS: International Council on Monuments and Sites

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