

Using GIS in Universities Campus Design, University of Jordan as a Case Study

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Abstract

The university campus is not only the buildings we see by our eyes, but also the place that makes our knowledge, which plunge our brains and reform it again. Therefore, it is mainly mental assemblies before it is visual composition. This paper focuses on using Geographical Information System (GIS) as efficient tool in urban design especially University Campus Design. Campus Planning involves the experience and goals of the target groups and the talent and expertise of the architect in addressing the long-range needs of schools. Many schools face the same constraints as commercial development projects, and indeed the history of campus design and town design has many parallels. In addition, schools have complex functional requirements that are often not well solved by monolithic institutional buildings. The space between the buildings is as important as the buildings themselves. **Therefore**, the goal of this paper is to build a geo-database in order to understand, analyze and predict how the campus will look like. Consequently, we will be able then to design and make a new master plan for the campus. This geo-database shall contain spatial and attribute data necessary for a good design. Additionally, it will be useful in the **future** since the updating of this geo-database is easy in GIS software. Not to mention that this geo database could be used as interactive map for the students, visitors and vendors of the university. Architects and Planners can take the students attitudes about the recent and future design of the campus and as well as all target groups ; to be more realistic in their designs.

Key words: Urban Design, Campus Design, GIS, Jordan

1. Introduction

Campus Planning involves the experience and goals of the target groups and the talent and expertise of the architect in addressing the long-range needs of schools [1]. Many schools face the same constraints as commercial development projects, and indeed the history of campus design and town design has many parallels [2][3]. In addition, schools have complex functional requirements that are often not well solved by monolithic institutional buildings. The space between the buildings is as important as the buildings themselves [4]. University of Jordan (UJ) campus suffers from main problems related mainly to the absence of a rigged master plan for the campus[5]. All plans found were for the existing situation not for the future unless the administrative authority want to build new school or college or investment buildings[6]. Always priorities were given to solid not vacant areas in campus region [4]. Furthermore, this poor planning reflected the relation of the campus with its urban surroundings and local community [5]. The completely academic progression has been affected seriously and badly due to absence of a master plan depending on scientific methodology. More ever, the main goals and strategic plan of the UJ could not be achieved. The result of this will be overlap and clash of uses of the lands and the buildings inside the university campus and site unsuitability for the buildings. In addition, accessibility is not obvious and there is a difficulty in movement inside and outside the campus for both pedestrian and cars.

2. Literature Review

The university campus is part of urban city context centerpiece from the surrounding environment and influences the local society directly and indirectly. Rigid master plan for the campus shall reflect positively in the progress of academic process. All actors in the university; students, teachers and administrative members will be more productive. The literature review search concentrate on using GIS in university campus design from different aspects Here are some case studies which might be related to the subject and could be helpful to understand the role of GIS in campus planning:

1- A GIS-based microenvironment analysis of the campuses of the Claremont Colleges [7] was conducted to assess the environmental impact of the campus footprint and to implement new ideas and approaches for advancing environmental sustainability. The project used concepts from information systems design science to provide a framework for assembling a GIS analysis engine to produce map images and data to explore economic, environmental, energy savings, and social outcomes of planting and preserving appropriate tree species. The framework assisted investigation of increasing the tree canopy coverage at various levels, as well as stakeholder preferences for tree types and aesthetic outcomes. In addition, the study's methods, outcomes, and limitations may be of interest to local and regional planning and sustainability administrators.

2- The College of Charleston Campus Map project was a student class project designed to improve the accuracy of the existing static map, and to create an interactive online map for the campus website [8]. Campus maps can provide useful information to prospective and current students, visitors, and on-campus groups including public safety and maintenance. The current campus maps at the College of Charleston are skewed for aesthetic purposes, and do not accurately depict geospatial features. The campus map created by the students in this project is GIS based and designed to provide highly accurate, printable static and interactive online maps for the College of Charleston community, prospective students and visitors. The College of Charleston is a public university located on the downtown peninsula of Charleston, South Carolina. The core campus area encompasses approximately a square half mile, and includes academic, residence, and support buildings. Spatial data collected from aerial ortho-photos, County databases, and field surveys were integrated into the Student Campus Map. The new map includes all current campus building locations, student and faculty parking lots and campus call box locations. The use of a geographic information system allows this map to be updated more efficiently than the previous maps and permitted the development of an interactive online map for use on the college web site.

3- Cultural researchers are increasingly turning to Geographical Information Systems (GIS) technologies for visualizing spatially oriented qualitative data [9]. This paper discusses one example, where mental maps have been employed in interviews with creative industry workers and the results accumulated in a GIS for visualization and analysis. This technique extends on participatory and qualitative methods that counteract overtly economic and empiricist techniques regularly employed in creative industry mapping studies. Collating together creative workers' mental maps within a GIS provides a means for exposing 'high traffic' areas—hot spots of creative activity—and other hidden geographies that comprise the 'creative city'. Key spaces, known within creative communities but understood by researchers only anecdotally, can be visualized with a GIS. The methodology was carried out in Darwin, the capital city of Australia's Northern Territory, which has sought to re-imagine itself as a creative city. Results from two mental mapping questions from the focus of this paper: on where 'creative epicenters' and 'spaces of inspiration' exist in Darwin. The former tend to centre on popular suburban sites and inner city spaces while the latter privileges open space and iconic harbor side settings. The differences and similarities between responses to interview questions are best revealed through 3D visualization. Outputs from this method incorporate vernacular voices into policy-making, and can henceforth inform spatial planning, allowing for the development of more spatially literate creative city policies that reflect creative workers' actual spatial proclivities.

4- It is widely known that greenery has positive impacts to the environment [10]. It is necessary to consider greenery as an important element in any contemporary urban planning. However, planners, estate managers and property managers are not able to assess existing greenery conditions in terms of quantitative data in order to achieve their goals in maintaining or improving the greenery condition. Thus, it is impossible to set a framework or plan to improve the environmental quality. The objective of this research is to develop a framework for planners to evaluate and to improve the greenery conditions in planning the urban environment.

5- The use and awareness of GIS is steadily increasing across institutions of higher education in the United States. With this popular growth comes an opportunity to establish greater awareness of mapping, spatial reasoning and geography in general. Many colleges and universities pursue and support active and problem-based learning approaches, undergraduate research programs, and service-learning and civic-engagement activities. General education courses are commonplace. By integrating GIS into these educational objectives, learning approaches and common curricula we create richer, more fulfilling educational experiences that profile the power of geography's spatial perspective. At the same time, we create opportunities for geographers and GIS scientists to consider new and innovative ways in which maps are being used.

3. Research Goals

1- Analyze and study the status of present uses of the lands and the buildings in UJ Campus using GIS technique focusing in the surroundings. Trying to understand and realize the historic development of this urban context there.

2- Create Geo- database for UJ campus Site contain all spatial features: point and poly line and polygon features .In addition to all necessary attribute data to be a helpful tool for architects and planners of the Master plan of the campus of UJ.

3- Study by using GIS the movement of pedestrians and cars, and it's relations to entrances.

4- Create relationships and functional connections between buildings, the exposed voids and real needs of employees, students and visitors of the campus in the light of UJ strategic goals and policies.'

4. Research Methodology

The research will depend on the inductive method;

- 1- Field visits and the interviews to the university campus site and surroundings
- 2- Literature review related to the subject.
- 3- Spatial and attribute data collection for the UJ from confirmed sources.
- 4- Fieldwork for missing data using GPS or micro station instruments.
- 5- Using GIS software(ArcGIS) to build a geospatial database and to make some spatial analysis(Figure1.) using the Google image and cad file conversion and Geo referencing(Figure 2.) .Then making the digitizing for the UJ campus .The attributes for different polygons ,poly lines and points of the digitized map were issued .Finally the Geo-database was ready for analysis and layout is done .

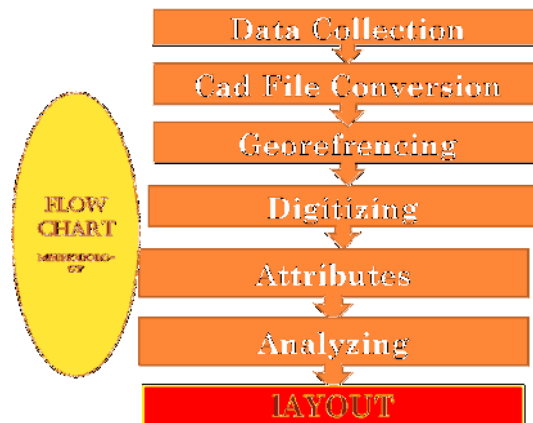


Figure 1. Methodology Flow Chart

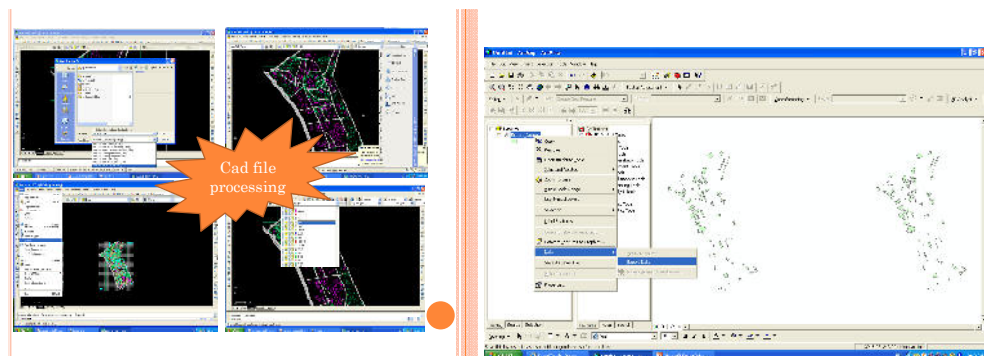


Figure 2. Cad file processing.

4.1 Research Data

In Figure3, you can see the main data used; In addition to paper map for the university from the engineering department of UJ, the cad file was an important source in the procedure .Satellite image was the base map used to make the Geo-database .Its new and geo-referenced image .It was taken from Google maps. Statistics of UJ was obtained from UJ departments.

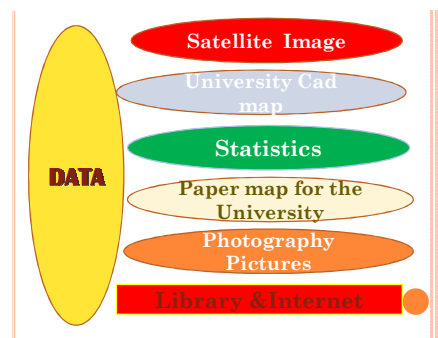


Figure 3. data used in research

4.2 Research Soft ware :

In Figure 4. you can see the main software used :Mainly ArcGIS to build the Geo-database for UJ ,beside AutoCAD 3D sketch and Google Earth.



Figure 4. Research software

5. Research Outcomes

- 1- UJ was established in 1962 in the north west of Amman city, and now it has now more than 40000 students, 12% are foreign students and 1200 staff member. More than 114 thousands graduate from UJ. It has 63 Bachelor Program, 81 Master programs and 30 PhD programs.
- 2- UJ Campus is about 120 hectare. It is a level and slope land covered with trees of the pine and trees of the ash and olives. It has the same as Amman West Mountains weather; cold in winter and fear in summer with many sunny days all over the year. Its shape is a semi rectangle (Figure 5.)

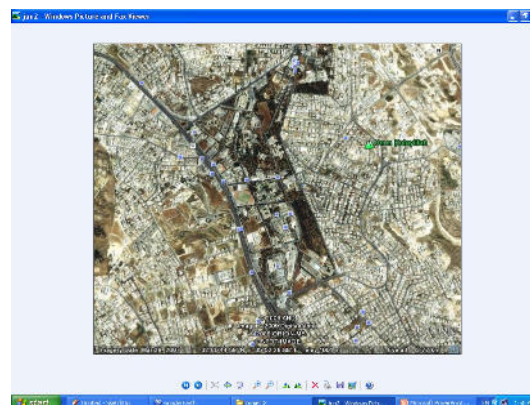


Figure 5. Google map Photo for UJ Campus

In the middle of UJ campus most of services and the enclosures fall which needs comply with the students, the bank, restaurants, and the main library, beside the Gymnasium and sport activities. The collages are separated to the south side that contains the scientific collages and the north side, which contains the humanities collages. University Hospital is in the south part near Medicine collage and the main mosque is near Al sharee'a collage in the north side. In addition, there are residential units for staff and students in the east north part. There are many of coffeehouses, restaurants, and big merchant, libraries, pharmaceutical, bakeries, banks, and coffeehouses of the Internet, and other on close distance from campus.

- 3- Architects and Planners for UJ campus suffer from the absence of a System relate between spatial and descriptive data in one plate ,help them in taking rational decisions and obtain fine master plans. Correspondingly, the students and staff find it difficult to share their opinions in the Master Plans for UJ as well.
- 4- The objective of this project was to conduct a geo- database (Figure 6.a) contains spatial and attribute data using GIS software ArcGIS 10.Their were 83 polygons done through digitizing represent the main buildings, Parks and open spaces in the campus and surroundings. Beside the digitizing of streets in and outside of UJ campus, land marks, gates and trees of UJ. All these features were put in more than 15

layers as seen in Figure 6.b .Symbolization for each layer was done. Then Attribute tables were edited for polygon, poly line and point layers.

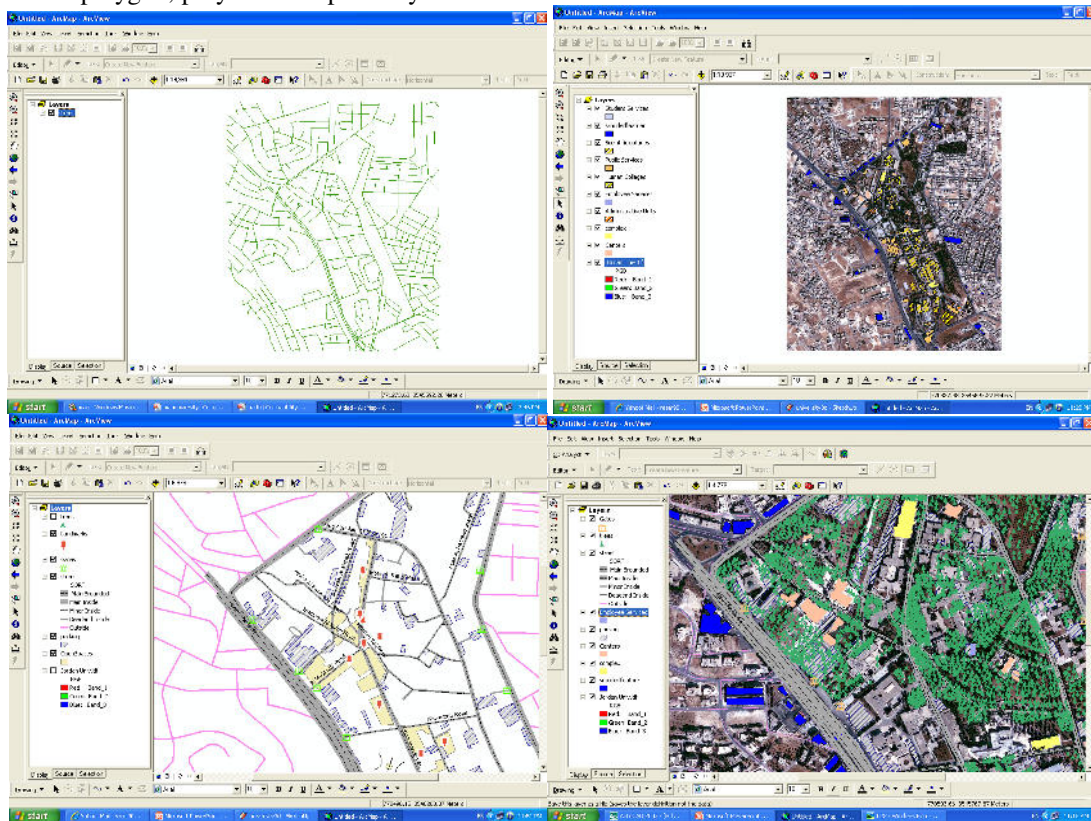


Figure 6.a Layer builds by ArcGIS

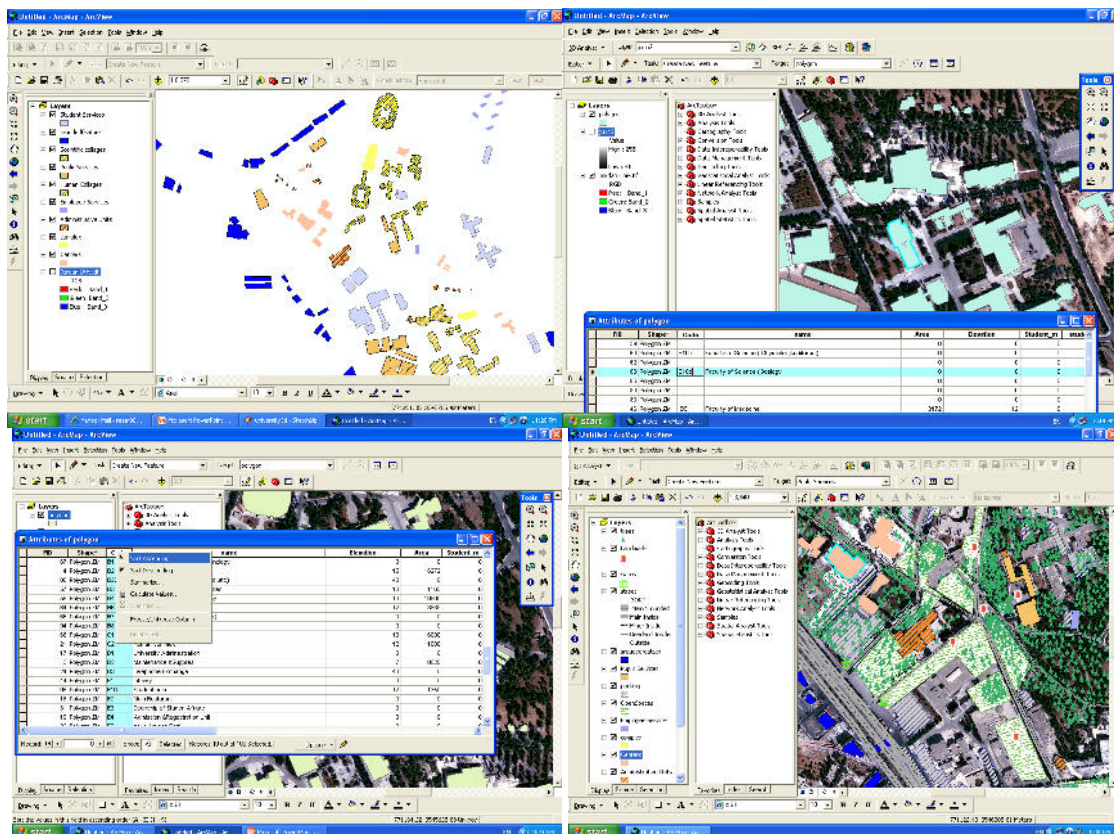


Figure 6.b Layer builds by ArcGIS

- 5- Classification was done to classify streets to five symbolized categories .Also, classification for parks was done to identify the parks for cars, busses, employees and students.(Figure7.)

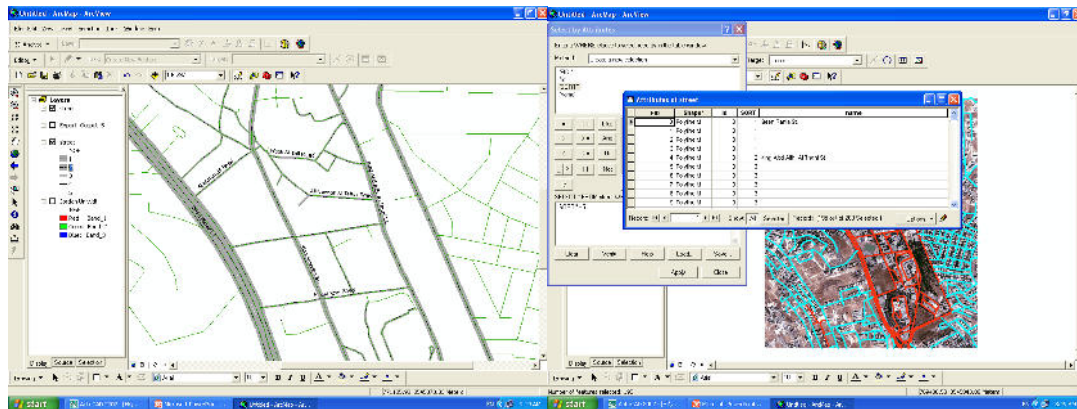


Figure 7. Classification for Streets and Parks

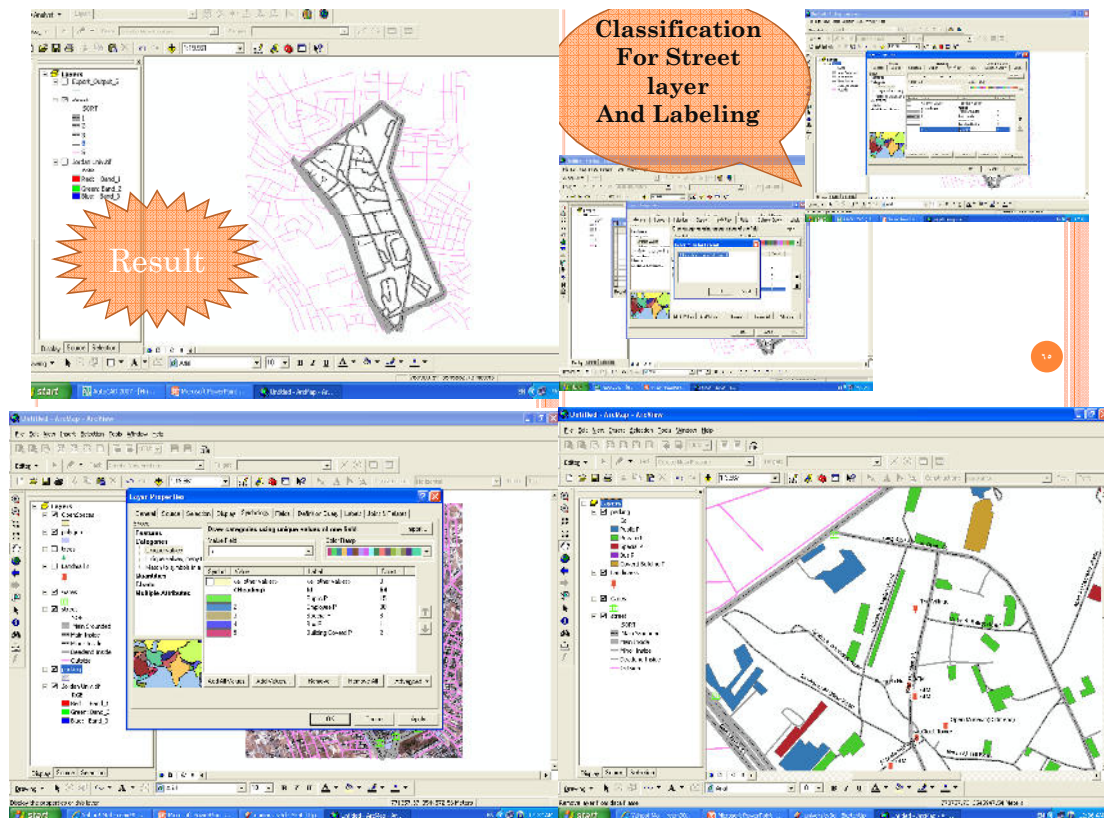


Figure 7. Classification for Streets and Parks

- 6- Using tools of ArcGIS, some analysis were done: making Graphs, reports, and some statistics analysis. Query, Select by location or Attribute, Area calculation for Parks, Buffer Zone for library to know the collages nearest to library (Figure8.)

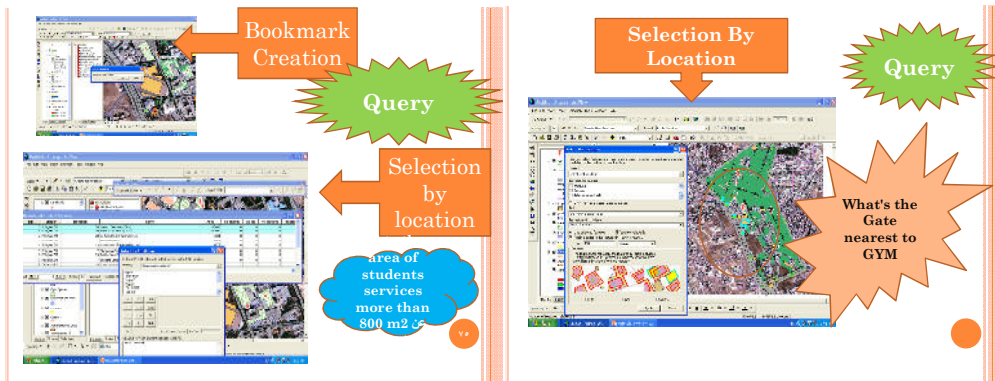


Figure 8. Analysis done by ArcGIS tools

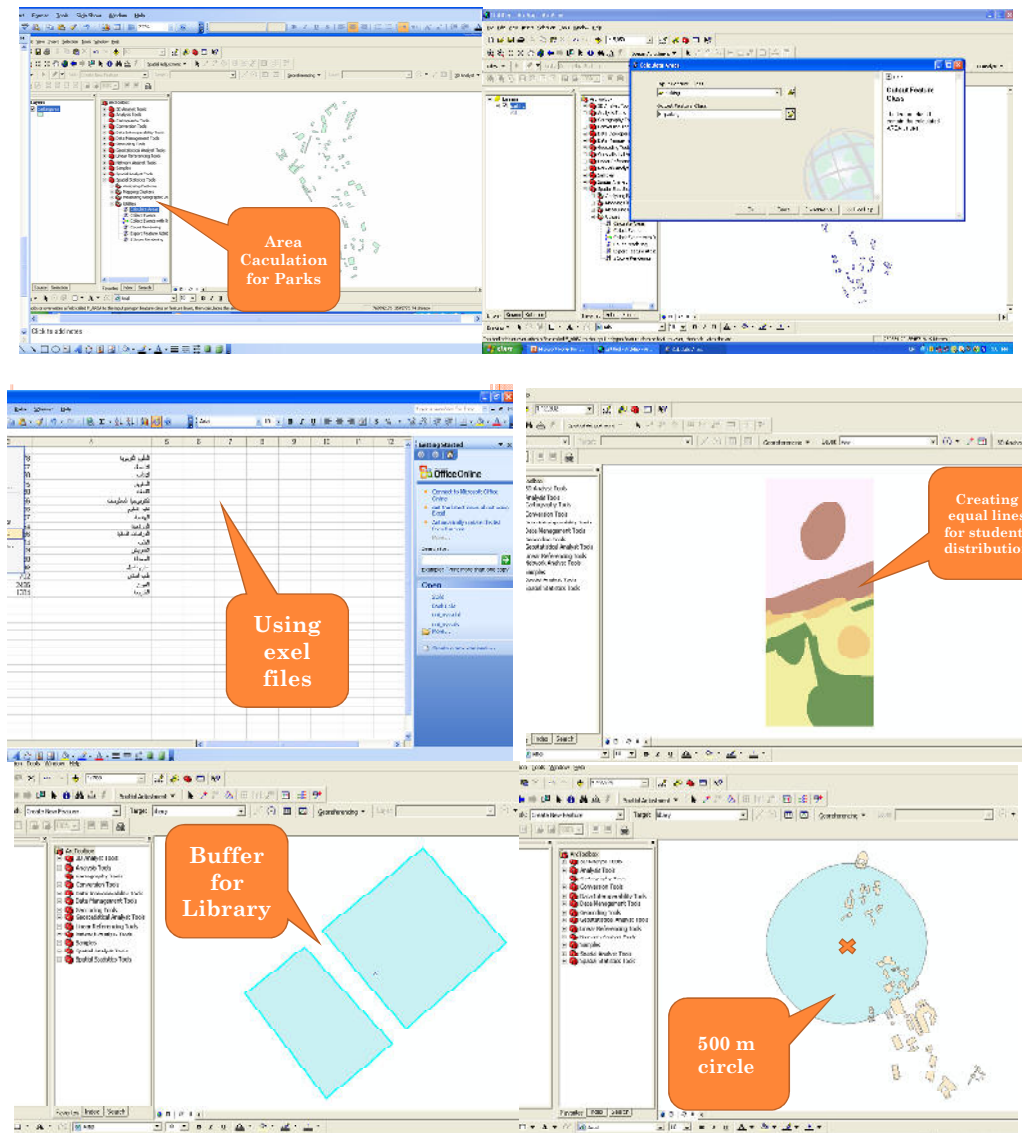


Figure 8. Analysis done by ArcGIS tools

- 7- Layout was created and is ready for publishing or plot at any scale desired(Figure 9.). legend and another data frame also created to concentrate in the area of collage of art and collage of business.

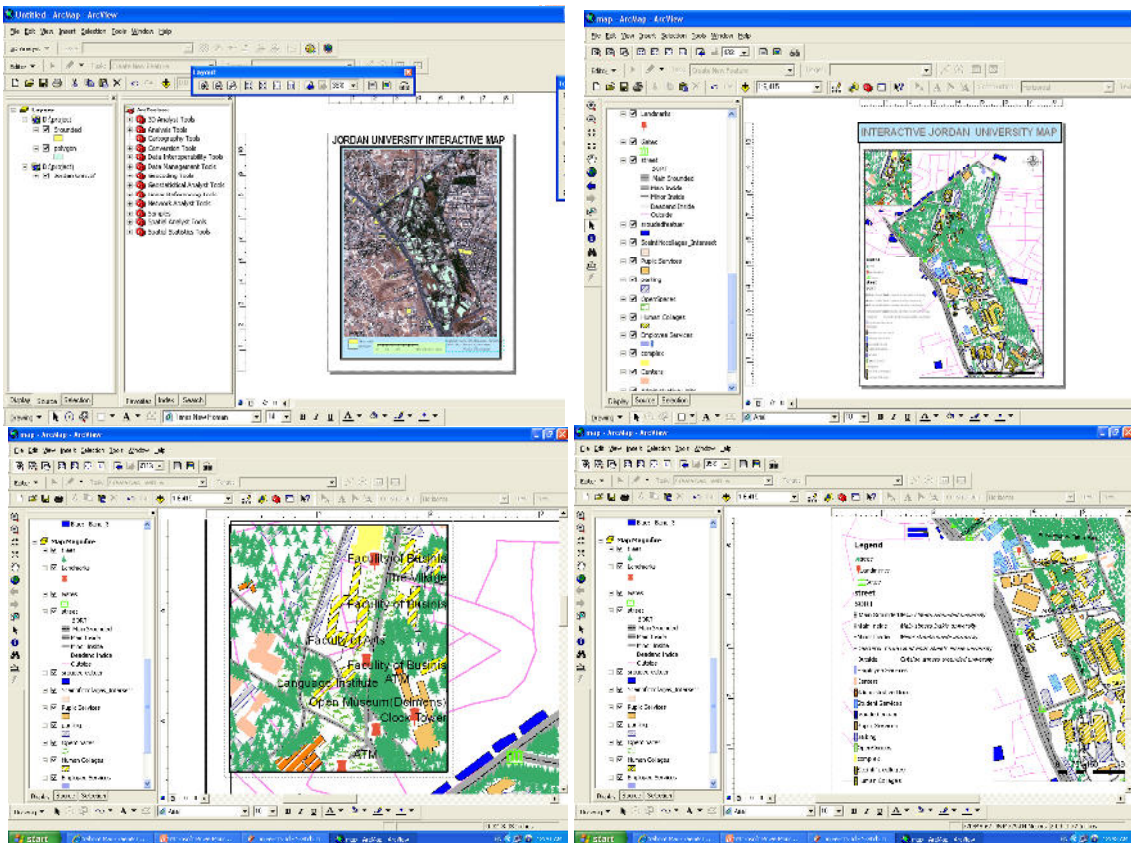


Figure 9. layout created for UJ campus by ArcGIS

8- By using the cad file and 3d sketch software, a 3d moving map was created. (Figure 10.)

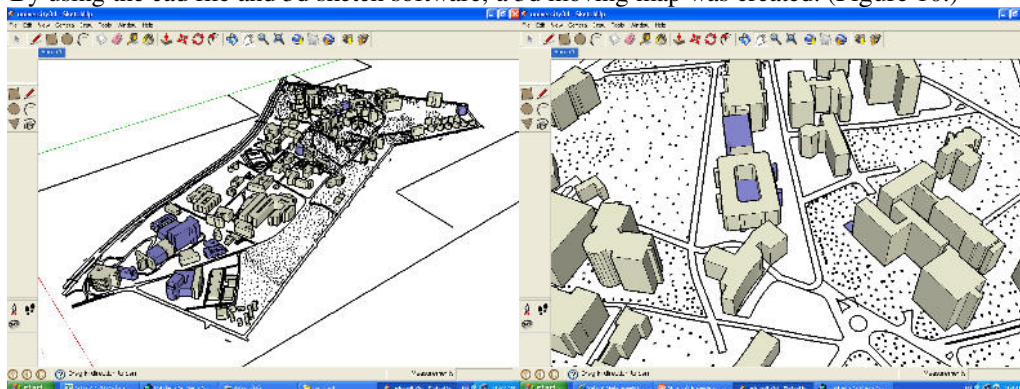


Figure10. Using 3D sketch software for UJ campus.

6. Conclusion

Finally, results from analysis indicates that the current geo-database need updating continuously and it is an important tool in the hand of planners and architects to enhance the master plan of UJ campus. Planners can use GIS efficiently to understand and find a better solutions for the campus problems .For example ,they can calculate easily the spaces needed for parking by this geo-database. In addition , they can solve improper movement especially for students and pedestrians to shorten the distance and time of their movements. Also, main library was far away from some collages and need a decision to decipher this issue. By publishing the geo-database of UJ camp map in a GIS server in the internet, students and staff can easily share their ideas and suggestions with architects and planners to participate in design process of campus master plan planning.

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