A case study to construct the planning base map and population density distribution for the third world urban area

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Abstract: Korean construction industry is actively participating in many city planning projects in the third world countries abroad. For the field planners, though, the immediate problem is the severe lack of fundamental public statistics and IT-based geographic information to perform spatial analyses and prepare master plans. This study, in this context, tries to simulate a process to construct a digitized base map of the area and to estimate the size of the local population. The study takes Bab Ezzouar of Algeria in Northern Africa, as the case area. The city planners and construction entrepreneurs might obtain a more reliable base map as well as the additional building bulk information so that the provision of development master plans could further be facilitated.

Keywords: third world countries; planning base map; building bulk; population density

1. Introduction

Recently, Korean construction industry is actively participating in various city planning projects in the third world countries around the globe including Southeastern Asian, South American, and African continents. For the field planners dealing with such projects, though, the immediate problem is the severe lack of fundamental public statistics and IT-based geographic information to perform spatial analyses and prepare master plans. This study, in this context, tries to simulate a process to construct a digitized base map of the area and to estimate the size of the local population of 'Bab Ezzouar' located at the outskirts of the Algiers, the capital city of Algeria, in Northern Africa. For the purpose, the study adopts the satellite map tile images covering the study area so as to digitize the roads and building structures. It then estimates the block-wise populations based on the building image interpolation as well as the supplementary field survey data in an effort to overcome the facing difficulties of deficient spatial and demographic data in the typical third world cities and surrounding urban areas.

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2. Study area

2.1 Study Area

The municipality of *Bab Ezzouar*, one of the most flourishing suburban neighborhoods near Algiers, the capital city, had been formed by the last municipal division administered by the Algerian government in February, 1984. Being located only about 16 km away from Algiers, Bab Ezzouar occupies an important position that makes it the front door to Algiers. As it covers the area of 828.8 hectare, its boundary is adjacent to: *Bordj El Kiffan* in the north; *Dar El Beida* in the east; *Oued Smar* in the south; and *Mohammadia* in the west (see Figure 1 for its location in a regional scale). Being one of the municipality of Eastern *Mitidja*, *Bab Ezzouar*, it introduces vast and often marshy flat expanses and is made up of areas mostly with gentle slopes that facilitate the construction.

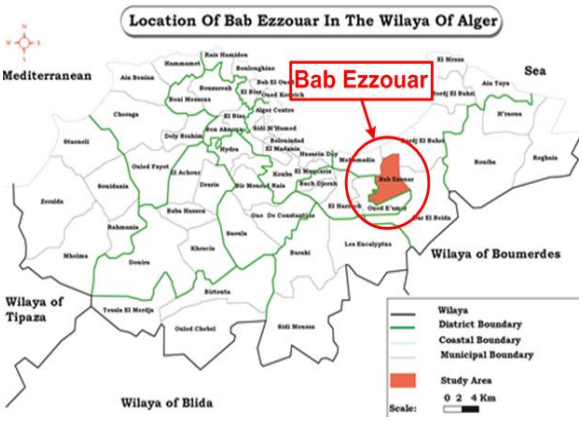


Figure-1 The vicinity map of Bab Ezzouar County

2.2 Data description

The primary demographic data for the study have been obtained from National Statistics Office (ONS) of Algeria as well as Bab Ezzouar City Hall. For spatial construction of the base map to assess the population distribution on the GIS platform, Google Map and World contour Map sources have also been adopted to build an accurate satellite map of the Bab Ezzouar vicinity and to abstract the structural information about the buildings, transportation networks, and topography of the area. In addition, the field survey had been done especially to take the pictures of the structure at each and every corner of the city for supplementary data to be used to interpolate the building heights and number of stories.

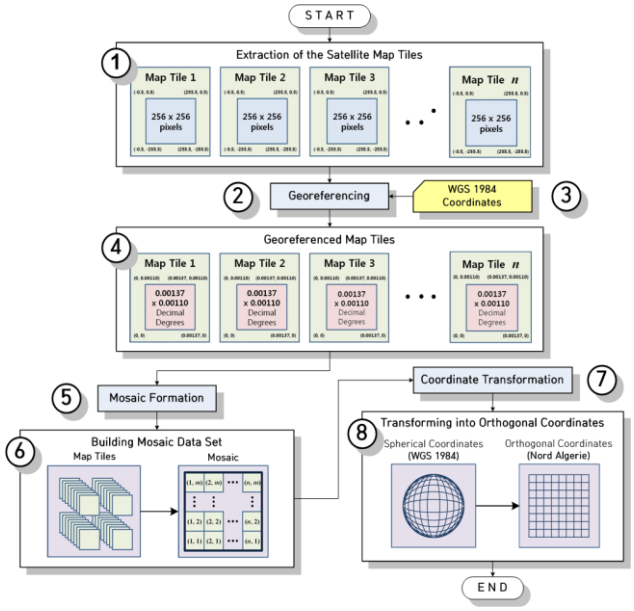


Figure-2 The flowchart to build the base map

3. Application

3.1 Building the mosaic map

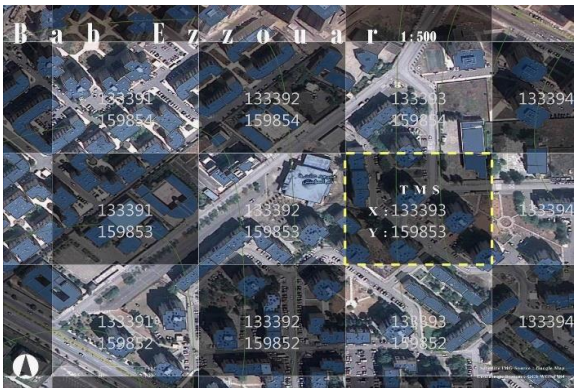


Figure-4 Mosaic map of map tiles

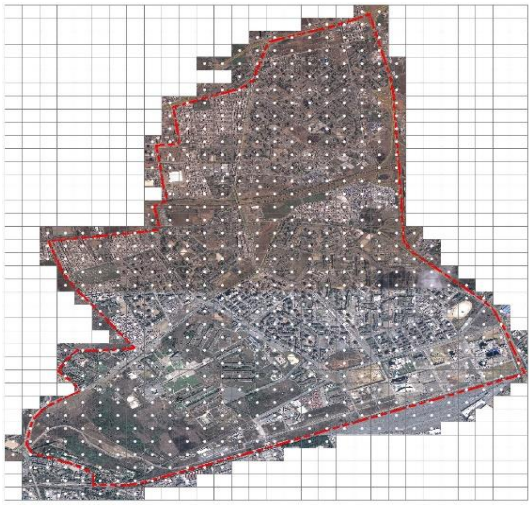
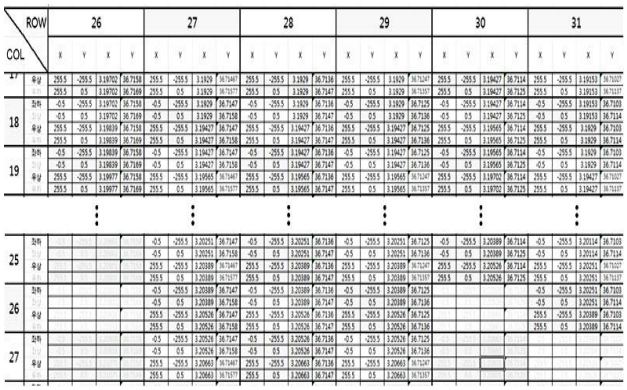


Figure-3 Completed mosaic map of Bab Ezzouar

Figure-2, in a flowchart format, shows the process to build the mosaic map to be used in this study. The process (1) in the figure extracts the satellite map tiles from Google Application Programming Interface (API) with the matching corner coordinates of each tile rectangle. Here, the Level 18 with the resolution of 256 pixels has been chosen in order not to let the base map of the study area to be of excessively high resolution whilst it should not lose sufficient spatial information for the purpose of this study. In the

process (2), the extracted map tiles are transformed to fit to the WGS 1984 coordinate system by georeferencing tools on the GIS platform. The numerical coordinates of the tile corners are substituted by the decimal degrees in the process (4). In the process (5), the corner coordinates are recalculated to construct the mosaic data set based on these decimal degree values. The calculated outputs are shown, for instance, in the spreadsheet format in Table-1. Finally, the completed base map is transformed from WGS 1984 to orthogonal coordinates of "Nord Algeria" coordinate system as indicated in the process (8) in the flowchart. Figure-3 illustrates an enlarged view of a sector in the study area built by the processes rendered above. Figure-4 is the base map of Bab Ezzouar County shown in its entirety.

Table-1 Calculation of four vertex coordinates for every map tile across Bab Eaaourar



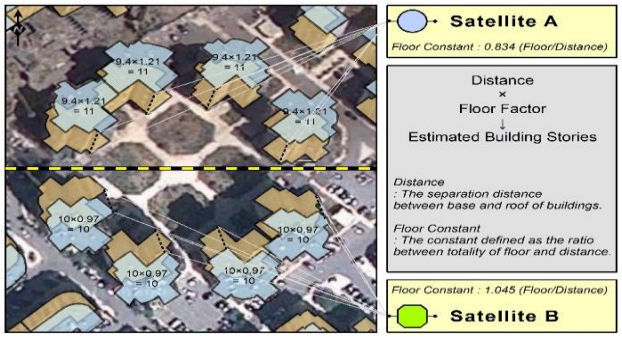


Figure-5 Correction of images by view angles

Figure-6 Photos to check the building stories

Table-2 Attribute table to calculate floor areas

Population	Commerce	Commerce Gross Area
3,276673	c	72,48652
5,65632	c	125,129046
0	c	82,85015
4,246868	c	93,949173
12,108766	c	267,869989
0	c	355,992857
34,273771	c	189,551
10,991394	c	243,151498
10,09154	c	111,622469
8,914693	c	98,605368
13,821217	c	152,876412
11,795423	c	130,469112

3.2 Digitizing the buildings

It is necessary, in the next step, to figure out the sizes and heights of the buildings as accurately as possible in order to estimate the distribution of population in the city. For the purpose, the roof shapes are digitized and it is projected downward to the ground level so that the 3-dimensional building bulk could be obtained. Since the satellite images are usually taken in different angles (as shown in Figure-5), the estimation should be adjusted, applying different proportion for each different map tile. Figure-6 shows an example as to how the supplementary building photos could be used to acquire the building heights and to confirm the

number of building stories. Table-2 is a sample calculation sheet to estimate the floor areas and number of stories.

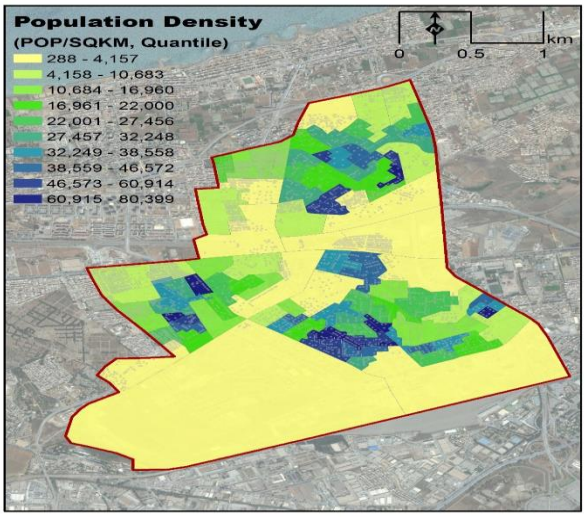


Figure-7 The jurisdictional boundary

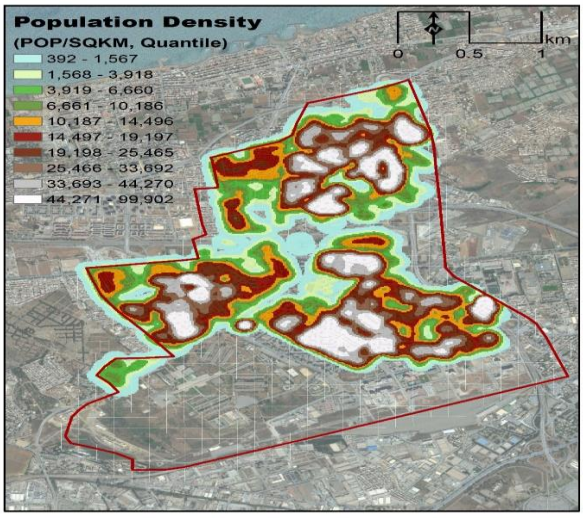


Figure-8 The jurisdictional boundary

3.3 Population density interpolation

Figure-7 is the population density map represented by the number of people per square kilometer for each census tract, which is directly calculated from the official raw data obtained from the ONS and City Hall. The data were surveyed by each areal unit of the local census tracts as of 2010. The population statistics, however, could be redistributed more realistically using the building bulk information obtained in the previous section. Figure-8 is the map that the correctional interpolation through the application of the accurate building bulks are made. To perform this: (1) total residential floor areas in each census tract are divided by the total population in the same tract so that the average floor area occupied by one person by the tract-basis is measured, then; (2) this average values are applied to each building in proportion to the size of the floor area of that building. As one can see in the figure, the population density distribution becomes more accurate, vivid, and, of course, practical, spatially.

4. Conclusion

Facing the adversities that arise from the typical lack of formal information and/or statistics needed to proceed the initial stages of the development projects in most of the third world countries, the city planners, real estate investors, and construction entrepreneurs could build the basic planning base map as well as the additional building bulk information to accurately interpolate the distributional densities of population in the target area by the method stated in this paper. As such, it is expected that the provision of more reliable development master plans could further be facilitated.

References

Algerian Office of National Statistics, 2008. *Statistical Directory*, Algiers: ONS, RGPH 1987-2008

Belhai, A., and Bouder, A., 1998. *Dynamics and Processes of Urbanization in the Urban District of Bab Ezzouar*. 2nd Conference on Land Planning.

Raymond, A., 1985. *Big Arabian Towns at the Ottoman Period*. Paris: Sindbad.

Sgroi-Dufresne, M., 1986. *Algiers 1830-1984: Strategies and Urban Stakes. Paris. Searches on civilizations*.