The use of smart remote sensing technologies in the development of master plans of cities on the example of the city of Basra

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Abstract. The aim of this paper is to use remote sensing data for developing smart technology in oil cities, Basra city as study area. Smart city is one of smart technology governments need to implement in oil cities to give suitable solution for audience such as easy transportation access between cities. The planning problem in oil production areas of Iraq, which is carried out on the territories of the cities is the lack of balanced policies aimed at their development, taking into account on the one hand, areas disturbed by petroleum activities on the other areas of the existing development in the settlement in other hand. Urban use of the areas disturbed by oil production requires right science-based decisions associated with the development of quantitative methods of accounting and evaluation of territorial -construction resource (TCR) in a particular urban territory. Success smart city in Basra city needs hardware, software, remote sensing data and users, network and good understanding of how smart technology working on. This research defined the required steps and roles to develop smart city technology in Basra city as one of Iraqi oil cities territories.

1. Introduction

The economic blockade and the wars against Iraq have created an extremely difficult situation for the population, and the quality of life has been reduced. Historical and cultural values and territories of cities were destroyed and have not been restored to date. The housing crisis for the population was disastrous, many of the residents were unable to build houses, despite the fact that they own land plots that the state gave them for free, Political differences and the lack of legal mechanisms for solving urban development problems have not been resolved until now on addition most lands of Iraq for oil and gas using. The territories of the republic are used for oil production and profit from the sale of minerals. Reconstruction of urbanized territories after war period the republic of Iraq is currently a prospective direction of state policy. The main task that requires attention is to create a comfortable environment for human activity in the post-war period and mapping territories so as to create good master plan and using new technologies such as GIS, GPS and remote sensing technology (3S) as a foundation of smart city developing. Cities and provinces of the republic of Iraq, despite their development, require special attention in the field of forming an urban planning and information system aimed at ensuring the environmental safety of the use of oil production territories.

The city of Basra, it is one of the most Iraqi provinces that contain oil contaminants having a lot of oil fields in addition to the high temperatures and lack of vegetation on one hand and Population migration irregular because of the war and the deteriorating economic situation in some neighbouring cities on the other hand, which invited the Iraqi government's thinking about development and solving...
urban problems by using smart technologies so that this development fits with the nature of the area and preserve the historical identity and civilization of the city.

Basra (researcher study area), coordinates 30.508520°N, 47.780399°E is one of the oldest cities in the middle east, Basra province is metropolitan city (see table 1,2), the third largest province (governorate) in southern Iraq as shown in figure (1). Borders Kuwait and Saudi Arabia in the South and Iran in the East. It borders the provinces of Diqar city and Meysan city in the North and Muthana city in the West as shown in Figure (2). Basra city has divided into seven region reigns Basra centre, Zubair region, Abo Alkaseb region, faw region, Shatarabar region, Almadena region and Alqurna region see figure (3). Maps done by using arc GIS software, ESRI production for mapping Basra features with scale 1/100 and build the data base.

Figure 1. Iraq Map, Basra city (selected part)

Figure 2. Basra boundary (source: researcher’s working).
2. Background

To implement smart city technology in Basra city that will improve a country’s economy, give the benefits to users and improve living as well. To get better understanding, we need to understand questions: what are smart technology basics and principles? What’s the relationship between it and 3S technology and so on?

2.1 smart city and 3S technology

Smart city” was started in 1990s to show how urban development was turning towards technology, innovation, and globalization [1]. Rapid population growth, the need to reduce the traffic jam which results in an environment away of pollution, governments look to the development of smart city by create suitable place for living, to reduce the journey or trip time from one place to another by provides intelligent and transport safety and provide time for city people and visitors and reduce pollution.

Smart city is one of important work in the earth in digital form, the concept of smart city offers an appealing approach to the fusion of different IT techniques aimed at optimization of the territorial

| Year | Population |
|------|------------|
| 1934 | 56,000     |
| 1947 | 101,000    |
| 1957 | 164,905    |
| 1965 | 301,950    |
| 1977 | 452,102    |
| 1987 | 702,105    |
| 2000 | 1,169,056  |
| 2007 | 1,912,533  |
| 2014 | 1,500,000  |

Table 1. Population Of Basra City

| City Type  | Population (p) |
|------------|----------------|
| Small city | 50,000         |
| Middle city| 50,000 – 100,000|
| Big city   | 100,000- 250,000|
| Very big city | 250,000 - ≥ |
| Metropolitan| 1,000,000      |

Table 2. Relationship between City types and population.

Figure 3. Basra Regions (source: researcher’s working).
management and urban development [2]. Designing smart city in oil cities such as Basra city needs connections based on geo-spatial information science and technology (GPS, GIS and RS). The modern urban planning sets high quality standards to the urban environment design and planning. Smart city must be connected with smart economy, smart people, smart transport, smart government, smart environment and smart living. We can use the 3S technology for developing lands for example in oil fields to create comfortable life for people as shown in figure (4) steps as following data entry and create networking depends on remote sensing data then doing spatial and non-spatial data then data analysis and management so as to get query functions in good ways using computers and smart phones from big database container.

![3S flow chart for developing smart city](Source: researcher’s working).

2.2 Smart oil fields

In recent year’s oil and gas companies have been developed from traditional ways to more integrated and smart operations. Smart wells and real-time automation technologies are highlighted and become very important for cites urban planning in one hand, environment and comfortable living on the other hand with condition connections oil wells with territory so as to give smart alert for peoples in oil field sectors and around area. Smart oil filed help companies to transfer data and information in intelligent way from the field to the control station to create big data helping peoples in other living activities, this technology helps the companies to better manage, enhance production and improves city planning to develop a sustainable environment and reduce environmental pollution. The modern urban planning sets high quality standards to the urban environment design and planning. The concept of smart city offers an appealing approach to the fusion of different IT techniques aimed at optimization of the territorial management and urban development [2].
3. Methodology and materials

Flow chart above in figure (5) shows the research methodology to implement smart technology in Basra city as following:

1. Data Collection;
   - studying area overview such as weather and populations,
   - using open street map as remote sensing data to map function zoning and roads networking, public transportation, water area and recreation

2. Data Editing, managing and Processing;
   - starting this step deepens on some factors such as population density, land use, pollution level, cultures or city history using query equation to subtract industrial areas, oil fields areas and agricultural lands.
   - using ArcGIS software as a tools as shown in figure (6) such as arc catalog for designing data base, arc tool box for analysis, table of contents to show and manage study area layers to study, analyse and map the research area and planning, studying pollutions, decisions making, and studying factors of oil production environmental pollution that affect the use of territories as well.

ESRI production, ArcGIS is good environment for representing two dimension features (X, Y) (2D), Geographic information systems (GIS) allow you to work in three-dimensional space, where the value of Z is attributively linked to a point with coordinates along the axes (X, Y) [3].
Study area has been classified into several zones to get better understanding and easy to study lands using ArcGIS 10.2 depending on online base map from the software itself. Zoning are water areas, oil lands (Government land), farmer lands, residential areas and industrial zone, and public utilities as shown in figure (6) in the table of content as list of layers.

Functional city zoning is a way used for dividing land use by its function, land use is divided in two ways depends on function and physical characteristics, for example of functional zoning would be an area that has designated zones based on a function such as an industrial zone, a recreational zone and a residential zone, and by its physical characteristics is defined in terms of characteristics like density of population, size, height, elevations, coverage etc. For Basra city has been classified depends on functional zone as shown in figure (7).
Transportation network in the city of Basra can be classified into several types according to their importance and allowable speed: expressway, highway I class, highway II class, collectors, and local shown in figure (8). Classification roads network in Basra city depends on the speed (see table 3).

Table 3. Roads classifications in Basra city. (Source: researcher’s working).

| Road Type      | Allowable Speed (Km / h) |
|----------------|-------------------------|
| Expressway     | 80-120                  |
| Highway I class| 60-80                   |
| Highway II class| 40-60                 |
| Collectors    | 30-60                   |
| Local         | 20-30                   |

4. Data analysis and Result Discussion

The analysis has been done in steps according to the criteria and roles for

- land use,
- public utilities, industrial areas, and
- Transportation network.

According to the standard requirements of environmental protection buffer zone has been created within 1000 m around land use parts like oil lands, farmer’s lands, and also industrial area and transportation area using this equation (Area can be developed) = \( \sum \) (oil lands - industrial area - farm land) can be selected areas for developing new city. Using this equation can get suitable place for developing new cities in Basra city which called Satellite city (proposed satellite city). Figure (9) shows existing and proposed satellite city, depends on information and factors, in (table 3 and 4) show roads types and allowable speed. According to speed function, time between large city center and other group of urban center should be 40 min or less.
Figure 9. Basra satellite city “existing and proposed” (source: researcher’s working).

Table 4. Basra transport data base (Expressway for example) (source: researcher’s working).

| ID | Shape | Length (m) | Length(km) | Velocity(km/h) | Time(h) | Time(min) |
|----|-------|------------|------------|---------------|---------|-----------|
| 2  | Polyline | 68599     | 68.5       | 120           | 0.57    | 34.29     |
| 3  | Polyline | 32438     | 32.4       | 120           | 0.27    | 16.21     |
| 4  | Polyline | 1388      | 1.38       | 120           | 0.01    | 0.69      |
| 5  | Polyline | 1079      | 1.07       | 120           | 0.009   | 0.53      |
| 6  | Polyline | 477       | 0.47       | 120           | 0.004   | 0.23      |
| 7  | Polyline | 504       | 0.50       | 120           | 0.004   | 0.25      |
| 8  | Polyline | 452       | 0.45       | 120           | 0.003   | 0.22      |

5. As a result of which
- Function zoning can be classified into oil land, farmer land, industrial areas and public utilities and applying buffer zone with 1000m.
- Transportation network and classified roads depends on allowable speed.
- Selecting areas for developing cites depend on criteria, factors and existing cities.

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