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DOMESTIC PARKING ESTIMATION USING REMOTELY SENSED DATA

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Abstract

Parking is an integral part of the traffic system everywhere. Provision of parking facilities to meet peak of demands parking in cities of millions is always a real challenge for traffic and transport experts. Parking demand is a function of population and car ownership which is obtained from traffic statistics. Parking supply in an area is the number of legal parking stalls available in that area. The traditional treatment of the parking studies utilizes data collected either directly from on street counting and inquiries or indirectly from local and national traffic censuses. Both methods consume time, efforts, and funds. Alternatively, it is reasonable to make use of the eventually available data based on remotely sensed data which might be flown for other purposes. The objective of this work is to develop a new approach based on utilization of integration of remotely sensed data, field measurements, censuses and traffic records of the studied area for studying domestic parking problems in residential areas especially in informal areas. Expected outcomes from the research project establish a methodology to manage the issue and to find the reasons caused the shortage in domestics and the solutions to overcome this problems.

Problem

Parking arrangements in urban areas are usually problematic since parking demand is always growing in accordance with social and economic development while parking supply is limited to the available spaces on the streets which are originally provided for relatively low traffic volumes of the early development stages. For all types of land-use this problem is markedly remarkable and especially in residential land-use where the streets

are practically planned and designed with relatively narrow carriage ways. Consequently, parking demand and parking supply has to be seriously investigated for both existing and planned residential areas specially in developing countries like Egypt. Egypt's population still grows - the annual population growth rate was 1.70 per cent by 2010. Also, the increase in car ownership levels creates parking problems and affects liveability in residential areas. All of these leads to issues and shortage of on-street parking makes problems for residents. This problem will be very complicated in the future if a policy and solution will not be established. In this study we provide insight in both parking supply and demand in residential areas and explore possible solutions.

Overview

Photogrammetry has been in studying of moving, automobiles speed in a traffic control system. An automobile on the highway is photographed from a police automobile behind. Hallert concluded that photogrammetry can doubtless be of great value for the practical application to traffic control (Hallert, 1971). Also, photogrammetry has been applied in the reconstruction of traffic accidents. Wolf and Janseen concluded that photogrammetry assumes an extremely important role in accident reconstruction since the above described accident related information quickly changes or disappears altogether (Wolf and Janseen 1980). Photogrammetry and Parking Studies, Aerial photography has been used to collect the necessary data for domestic parking (El-Nokrashym and et al ., 1992; Ramzi, 1995). The application of photogrammetry in demographic studies deals with the residents as individuals of the population. However, in parking studies residents are further viewed as road users and the surrounding spaces will be viewed as spaces also available for traffic purposes. The traditional treatment of the parking studies utilizes data collected either directly from on street counting and inquiries or indirectly from local and national traffic censuses. Both methods consume time, efforts, and funds. Since the successful launch of very high resolution sensors, especially IKONOS-II with 1 m Ground Sample Distance (GSD) and QuickBird with 0.61 GSD, many researchers have considered them as possible substitutes of the classical aerial photos used for cartographic purposes at large scales (Fraser, 2002; Kay et al., 2003; Chmiel et al., 2004; Pecci et al., 2004). Satellite remote sensing has displayed a large potential to obtain information on urban housing development state. Without this

information on urban housing development state, an effective urban planning is hardly possible. Satellite data less than 1 m spatial resolution are available now. Satellite data have been used to detect the changes of large land-use areas (Jensen et al., 1993; Macleod and Congalton, 1998; Ridd and Liu, 1998; Prakash and Gupta, 1998). QuickBird imagery are accurate enough for mapping purpose up to scale 1:2500 (Ramzi and et al ., 2009), The urban planners require up-to-date information to make and implement the city plans. Therefore, the maps should be produced and regularly updated with the changes (Ashraf, 2004; Mahmoud, 2004). 2D second order rectification models are more appropriate for cases where the perspective and elevation effects are smaller like in our case to minimize the effect of tilt and relief displacements (Ashraf et al, 2007; Mohamed, 2006; Elghazali, 2005). Wang and Yun Zhang, (2003) extracted roads from Quickbird images using classification techniques. Qualitative analysis of visual interpretation of single QuickBird imagery explained that netrwork roads and built-up areas can be easy identify and extracted (Ramzi et al., 2008).

Study area:

In this study, Qabaa city Egypt, which has a flat topography is chosen as a test area The test area is covered by Geoeye1- , 0.5m resolution, panchromatic standard, date 06/09/2011. The Area of Interest includes different types of man made features and the characteristics of narrow roads low level of economic and high prices of land, rapid growing of population and lack of up to date large scale maps.

Methodology

The general methodology is to compare parking demand with supply to identify the parking deficit. Parking demand is based on the type and amount of various land uses in the study area. Parking supply is based on available on-street and off-street parking inventory in the study area. The general approach to achieve the objectives of the project can be described in the following points:

1. Data collection

These will include the following items:

- Remotely sensed data
  VHRS images, GCPs, CPs and maps covering the study area.
- Census data or Demographic data of population.

Population can be estimated from mono rectified image using many methods. In this study population can estimated from mono rectified image Geoeye-1 by producing large scale map after finding the number of residential building, area of each building and the average number of stories. Based on the average size of each apartment, the average number of stories and the average household size population can be estimated using equations (1) and (2). After collection the following items from statistics Year book and field:

Total number of apartments/building = (Area of building average size of each apartment) * average number of stories (1)

Population = Total number of apartments * Average household size (2)

- Traffic data:

a. Parking stall

a. Parking space dimensions or Parking stall:

The area necessary for parking supply is dependent upon the space needed by the parked vehicles and the space needed for parking maneuver. The total space is dependent upon the geometry of parking stalls, i.e. parallel, angled or right angled parking. For on street parking in GCR, the 1977 Cairo University study gives average values based on field observations in CBD of Cairo. It could be concluded as a result of this study that for parallel parking, the necessary space corresponds to curb length of 4.5m per car, while for perpendicular parking the needed curb length is reduced to 2.5m.

b. Car ownership.

Car ownership can be determine from statistics year book year 2006 last census and forecasting it to year 2011.

c. Field Observation and measurements

Average size of each apartment
Average number of stories
Off street parking
legal parking supply
illegal parking or domestic parking at night.

Parking Estimates:

Parking demand can be defined as the number of vehicles expected to be looking for parking opportunity within a certain area for a specific time period. For such residential area parking demand is usually peaks at night. It is a function in car ownership and can be estimated from the following equation:

Parking demand = Population * Car ownership ... equation (3)

Parking supply in an area is the number of legal parking stalls available in that area. This means that parking supply is the summation of on street and off street parking. To estimate parking supply for Qabaa city from mono rectified satellite image by extracting the following data: measuring all road widths and all curb faces lengths, and converting this lengths to parking spaces or cars based on roads widths and the possible type of parking

Results

Five ground control points (GCPs) and nine check points (CPs) has been used for geometric correction of .Geoeye-1 image using 2D second order polynomial function. The result shows that the total RMS error on GCPs and CPs meets the specifications of large scale maps. Image enhancement techniques improve the quality of an image as perceived by a human. In our case edge enhancement has been used. In this study, visual classification of buildings, parcels and roads in the study using Geoeye-1 rectified images and ARCGIS software has been done. In summary, the results show that:

- All buildings can be identified by the pattern that they make in conjunction with the roads. Individual houses and other buildings can also be identified as dark and light tones.
- All roads with their categories secondary, local access and Alley are visible due to their shape (straight in many cases) and their generally bright tone contrasting against the other darker features. Also, from recertified images all road widths can be measured and classified. After that roads function and parking type has been classified according to their widths.

Table 1 shows road Categories, widths, function and Parking type. Based on measuring from rectified satellite image, statistical and using equation (1),

(2) and (3) both parking supply and demand has been estimated. Table 2 shows parking supply and demand

Table 1. Road Categories, widths, function and Parking type

Road categoriey	Width (m)	Function	Parking Type
Secondry	More than 8m	Traffic and servicing	Parallel or angled parking
Local access	5-8 m	Traffic and servicing	Parallel parking
Alley	Less than 5m	servicing	Parallel parking
Alley (closed)	Less than 5m	servicing	Parallel parking

Field Observation:

- Average size of each apartment=107 m2
- Average number of stories = 8 story
- legal parking supply = 3916 car
- Off street parkingt = 134 car
- Un occupied parking stalls (due to observations) =71 car
- illegal parking or domestic parking at night=258 car
- Parking types are on and off street parking and garage parking. On-street parking is limited with streets widths and lengths it contributes with small ratio in parking supply. Streets are not well designed to meet the requirements of parking supply in informal areas. Streets should also allow for moving vehicles and pedestrians.
- There are many illegal parking causes problems of moving traffic inside the study area especially at night.
- There are much other activity in residential areas such commercial, industrial and others activity leads to there is many obstruction on the platform prevent pedestrians from using the curb from parking.
- Absent of town planning this leads to narrow streets.
- Absent of garages in most buildings.

- High prices of land leads limited vacant space sand the height of buildings more than the allowable height.
- Many residents put obstructions in front of their building prevent people from parking especially in front of shops.

It has been found as presented in table 2 that: Percentage of error in calculation parking supply fro satellite image and field observations is -2%. Percentage of error in calculation shortage in parking stall from satellite image and field observations is 11.8%. Taken into consideration off street parking and un-occupied parking stalls rectified images lead to more accurate results in calculation parking demand from satellite image.

Table 2. Parking supply and demand

Region	Method	Parking supply (car)	Parking demand (cars	Shortage (car)	% error
Qabba	Rectified image	3835	4194	359	11.8
	Field	3916	4237	321	

Suggested soluations:

- Based on the rectified geoeye-1 satellite image and the produced large scale map, it has been suggest two vacant spaces, one in middle and the other in the east of the study area. This vacant spaces can be used as open parking garage to solve the shortage in parking spaces.
- Law of buildings should be applied to control the problem of domestic parking.
- Absent of town planning leads to creation informal residential regions.

Conclusion:

From the research the following conclusions can be drawn:

- Parking arrangements in urban areas are usually problematic since parking demand is always growing in accordance with social and economic development while parking supply is limited.

- Very high resolution satellite image can be used for estimation both parking demand and parking supply.

- It has been proved that Geo eye-1 satellite imagen can play an important role in calculating parking demand and supply with sufficient accuracy.

- The value of the method of collecting data from remotely sensed data lies in its ability to produce representative results for large study areas in a very short time.

- Field observations are very essential to calculate parking demand.

Recommendations

- Re-calculating the results using stereo satellite images.

- The proposed methodology with appropriate modifications should be encouraged to be applied for parking studies in urban land uses other then the residential like commercial land use, the central business districts in particular, industrial land use, cultural and recreational land uses, etc.

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ОЦЕНКА НА ПАРКИРАНЕТО В СТРАНАТА С ПОМОЩТА НА ДИСТАНЦИОННИ ДАННИ

Рамзи А. И.

Ключови думи: Възможности и търсене в паркирането – Дистанционни изследвания – Извличане на пътища

Резюме

Паркирането е неразделна част от системата на уличното движение в цял свят. Осигуряването на паркинги за задоволяване на потребностите от паркиране в милионните градове винаги е било предизвикателство за експертите по улично движение и транспорт. Нуждата от паркиране е функция на населението и броя на притежаваните коли, който може да бъде установен от статистиката на уличното движение. Паркинговата доставка в дадена област се изразява с броя на наличните законни паркоместа в тази област. Традиционният подход в паркинговите проучвания използва данните, получени пряко, чрез преброяване на улицата и запитвания, или непряко, от местните и националните статистически данни за уличното движение. И двата метода изискват време, сили и средства. Другата разумна възможност е да се използват евентуалните налични данни, получени дистанционно от спътници, изстреляни за други цели. Целта на настоящата работа е да се развие нов подход на базата на съвместното използване на дистанционни данни, полеви измервания, преброявания и записи за уличното движение в изследваната област за изследване на проблемите, свързани с паркирането в жилищните и особено, в неформалните области на страната. Очакваните резултати от изследователския проект са да се въведе методология за управление на проблема и да се установят причините, предизвикващи недостиг в паркирането в страната и решенията за преодоляване на този проблем.