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Research paper



Geomarketing using Remote Sensing: a Study on Marketing and Planning Development Strategy at Northern Riyadh

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Abstract

Determination of market size is a critical factor for the success of any company or business activity. This paper presents a study to provide a clear vision using remote sensing for Geomarketing and industry purposes. In order to estimate market size in the study area based on spatial data, Satellite images, Spot 6, with a 1.5 m resolution, will be used with two different dates during the year 2016. It is used to determine the growth in the housing sector with building types and construction levels in the micro-geographic area of Northern Riyadh. It is also used to identify the expected need for products of each district and the approximate time required for installation. By using remote sensing data for Geomarketing, strategies for marketing, planning and housing development could be setup.

Keywords: *Geomarketing; GIS; Market size; Micro-geographic area; planning; remote sensing*.

1. Introduction

The smart using of marketing with geospatial data is the Geomarketing which is an intelligent integration between locations and Geodata with a range of business, including marketing, sales, distribution, and forecasting. Describes the use of components and geographical elements in marketing activities, including data collection and analysis, to guide business in a suitable and proportionate manner with new concepts and significant efficiency enabling Geomarketing to develop planning processes in line with market reading and improvement [16], and identify market movements while improving access to consumer service in a timely manner.

The power of Geographic Information System (GIS) is the ability to integrate with data from different sources like spatial marketing data in one map [15], which helps decision-makers to direct marketing activity in line with actual market needs, parallel to any competition or lack of information that helps increase the efficiency of logistics operations and business, with the ability to analyse and inquire. This serves to develop marketing strategies and business better than if marketing was used separately.

Long-term market forecasting [16], methodologies will become more flexible and effective with the development of Geomarketing [15] methodologies that include market segmentation into Micro-geographic areas. To identify growth areas to better guide activities that includes greater flexibility in developing a Geomarketing strategy to ensure dynamic decision-making.

Geomarketing is a relatively recent science. Its use in Saudi Arabia is limited to several telecommunications companies and is rarely used to develop plans, identify market size or develop knowledge about attractive investment opportunities. With post-2000 growth in Saudi Arabia increasing dramatically; especially in urban sectors associated with others factors i.e., food, building materials and communications, the presentation of this paper is a development of the Geomarketing strategy to support improvement in market forecasting [3].

2. Literature Review

Last year's many researchers used Object-oriented segmentation and classification method to extract the buildings by using the texture, satellite images specifications and shapes feature [1]. Jian and others developed the Object-oriented classification to have individual object-classes and fuzzy to identify the conditions and created it for earthquake collapsed building extraction [3].

The Buildings extraction did by using different scale for different buildings type which did by Huang and lot of researcher, the results merged as a whole, automatic building extraction Suggested another index by using high-resolution images with optimization and improvements [2], Jian yang used new technique to extract the building information by combination the contoured transform and PCNN segmentation algorithm to extract the multiscale and multidirectional characteristic of the building.

Other efforts have been made to extract buildings in automatic ways. Applied the Perceptual grouping way to extract the building. Lin and Nevatia detected the edges of the image to find the parallel lines from the edges. After that, they searched for the parallel lines to find a rectangle which meets the geometric and projective constraints as the building object, [4]. A study proposed a building extraction method by combining edge preserving, smoothing bilateral filter by using software like Erdas imagine to detect the line segment. Wang used a smooth filtration for the space image, detected the line segments and grouped it to construct a rectangular building, so these methods are suitable for extracting simple rectangular buildings, [6]

Li et al suggested to a hierarchical extraction style with a visual graphical topic model to extract the buildings by using simple or difficult patterns. In this method, buildings with simple rectangu-

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lar pattern and non-buildings were detected and taken to be the training set firstly. Then a learned semantic feature mapping and discriminative model were used to extract complex buildings, [7].
A recent research done by Tan and Yu is that adopted an energy minimization model for semi-automatic building extraction from very high-resolution images. The proposed framework consists of two main stages: generating foreground and background area, minimizing the energy function, [7]. the classification of high-resolution images was studied by a lot of researchers. More recently, smoothing texture and more accurate boundaries of the building can be obtained from HSR imagery and applied it to extract the build, [8]. But as he told its not suitable to use computers programs discern building types from high-resolution images, because it is hard to find appropriate segmenting scales to completely capture even an individual building from complex patterns of combining pixels [9], DEM data and building contours have also been applied in classification of building type. Ranging (LiDAR) and Airborne light detection are particularly useful to collect the elevation data for creating of building structural characteristics, [10]
In EMRS-SBP scheme, (Extended multiresolution segmentation) EMRS serves to guide the design of descriptor and SBP to conduct a more useful classification for the urban building type classification, [11]. The detection of changes by remote sensing has been applied to many fields like agriculture and urban area. It has attracted considerable attention in recent years because it is an effective way to find differences between images with different dates. Typical methods often take spectral characteristics first and then use threshold fragmentation to detect the changes. However, thresholds are usually determined through the experiment, leading to a series of problems [12]. Huo and Cheng introduced two multi-fusion strategies conducted experiments on the QuickBird high-resolution remote sensing images and complete detection of the object-oriented change. But the robustness of this algorithm is not good enough [13]. Guo and others studied a new way of multi-sectoral segmentation and resolution-level fusion. Multiple segmentation refers to the same division of the image in different scales, and the division results can reveal the characteristics of the multi-band land cover and geospatial information.
GIS used to support the decision maker in many fields like select the best site location and working to decrease food waste, [15], decision making is based on big data related to the problem. Many of researchers told that 80% of the data used by managers and decision-makers is geospatial data, the geographic information system used in the most important and extensive decisions faced by operations managers is to determine the location of new services facilities. This is a strategic decision for companies, GIS is tools to solve the spatial decision problem typically involves a large set of feasible alternatives, [16].
Arvydas studied Jadevicius and Simon Houston
Statistical estimates and predictions are based mainly on mathematical equations and modeling to help create projections that give a picture of the status quo, which helps to predict the problem. Researchers should put simple method at the heart of their expectations. Use techniques and human experience to help predict or employ a combination Prediction approach [16]

3. Study Area

The study area in this paper is located in the northern part of Riyadh city as shown in Fig. 1; which is the political and economic capital of the Kingdom of Saudi Arabia. It is the largest city in the country and 20% of the population lives there; according to the 2010 census. It is one of the most developed cities; especially after 2000. The study area is separated from the rest of the city by the north ring road; which was originally built to surround the city but is currently in the middle of it. Villas form approximately 70% of the total housing in Riyadh city; and are used predominantly by Saudis due to their need for privacy. Meanwhile, the foreign population lives in apartments due to their acceptable prices compared to villa rental fees. The study area is approximately 18% of Riyadh city. Many officials and businessmen live in palaces and large villas in this area due to certain characteristics that include a cooler climate than in the south, green spaces and wider streets than the rest of the city.
According to the 2010 census (Authority of statics, 2010):

- Population - 5.7 million
- Population growth rate - 4% per year
- Number of houses - 960,000 units
- Number of schools – 3060
- Number of hospital beds - 14137
- Saudis between 15-60 years of age - 60%
- Average family size - 5.97
- Riyadh City area - approximately 1400 sq. km
- Study area - approximately 240 sq. km
- The study area approximately 240 sq. Km

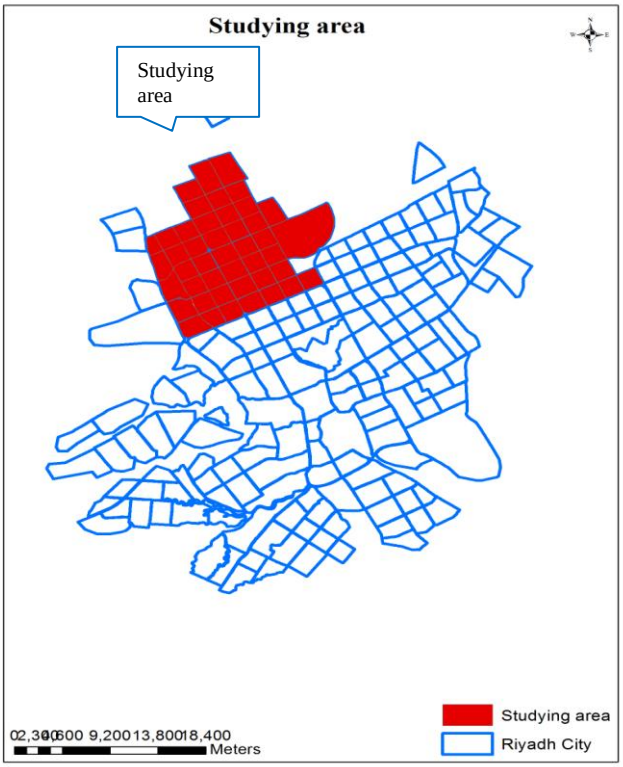


Fig. 1 Studying area location

4. Data

4.1. Remote Sensing

Two high-resolution satellite images, with two different dates, were used for the studying area. The specifications were:
Satellite: Spot 6
Resolution: 1.5 m, colour

The first image which was taken in January 2016, is used to create a feature class containing all existing buildings at that date, classified according to building type and construction level. The second image in Fig. 2 which was taken in October 2016, is used to create a feature class containing new buildings constructed after the date of the first image, to identify the exact number of new buildings created in the study area; classified according to building type and construction level as in Table 1.
The construction stages are:

- Basements

- Under construction
- Construction completed

Table (1): total number of buildings scanned in October 2016

Building type	Building Stage			
	Basement	Under construction	Construction completed	Grand Total
Apartment	81	127	221	429
Compound	1			1
Esteraha	20	14	23	57
Gas Station	1	2	5	8
Governmental		1	2	3
Mall	1			1
Mosque	2	5	8	15
Palace	6	9	3	18
School	4	4	1	9
Showroom	34	21	39	94
Tower		5		5
villa	764	640	2222	3626
warehouse	2			2
Sum	916	828	2524	4268

Table 1 shows the classification of new buildings according to the construction type and the construction stage obtained from the analysis of the satellite image for October 2016, showing that the largest number of new buildings are villas while the second class is Apartments. Fig. 2 shows a real example of the distinction of Apartments from villas through satellite images interpret where the Apartments are located near the main roads, while the villas are located most often within the districts



Fig. 2: The spot 1.5 m Satellite image (October 2016)

4.2. Survey

This study aims to increase market size identification accuracy by remote sensing. One building material product was studied to estimate the expected demand of this product (i.e., switches and sockets) during a specific period and estimate cumulative demand. To achieve this goal, a field survey of a sample of electricians and contractors (50 people) was conducted in the study area to determine the average need for each building type (i.e., villa, apartment, palace, mall, mosque etc.) for this product during the finishing phase. The survey included the following questions:

- The average number of pieces (switches and sockets) needed for each building type (Table 2).
- The expected time for this product to be installed for each building type (Table 3).

Table 2: Explain the average number of pieces for each building type

Buildings type	Switches Average(pieces)
Villa	193.66
Apartment	771.37
Esteraha	48.63
Mosque	104.67
tower	4188.44
Gas station	93.22
Industry	300.00
School	425.56
Mall	227.25
Showroom	351.38
Palace	2000.00
Warehouse	50.00
Governmental	1613.25

Table 3: The duration of the stage for building type

	Duration of the stage (month)		
Building type	Basement	Under construction	construction completed
Apartment	6	12	24
Esteraha	3	6	12
Gas Station	3	6	12
Governmental	6	12	24
Mall	6	12	24
Mosque	6	12	24
Palace	6	12	24
School	6	12	24
Showroom	3	6	12
Tower	6	12	24
villa	3	6	12
warehouse	3	6	12

4.3. Open Street Map

The road network in the study area was obtained using the open Street. It was checked, completed and classified into main and secondary roads, to help classify buildings where apartments are often built on the main roads, while villas are inside districts alongside secondary roads. The roads also helped to demarcate the boundaries of the micro-geographic area as in Fig. 3.

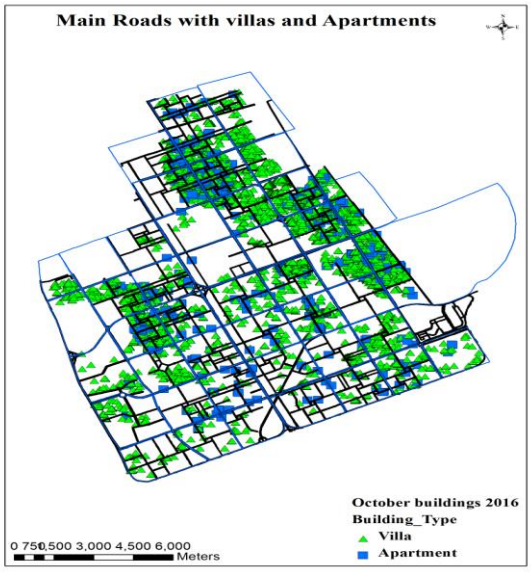


Fig. 3: Main road with apartments and villas

5. Methodology

A geographical information system (GIS) was used in this study to identify existing and new buildings; determined depending on experience and image interpretation by manual digitization. Point was placed in front of each building along with its classification according to building type and construction level for the second image (dated October 2016).

The types of buildings were determined as follows:

- The majority of the buildings that are next to the main roads are apartments; which is a feature of the building system in Saudi Arabia; especially in major cities.
- Villas are located inside districts next to secondary roads.
- The Esteraha is a building consisting of several rooms and one floor. It has a small garden with a pool and is usually rented during the holidays.
- Towers are high buildings with more than ten floors. Like hotels, they are usually located next to main roads, such as King Abdul Aziz Road or the Northern Ring.
- Mosques have distinctive, especially the towards of mihrab to the Qibla
- Gas stations.
- Malls usually occupy large areas.
- Showrooms are usually characterized by large buildings and their positions near to main roads.
- Schools and government buildings are characterized by the occupied area and their method of construction; consisting of four blocks in general and especially for schools.
- Palaces and large villas are characterized by large occupied areas, located inside districts with green areas within.

All types of buildings are identified by the satellite image and classified according to construction type (see Table 2) and construction level, which includes:

- Basement
- Under construction
- Construction is complete

To explain this methodology, one villa needs 193 pieces (switches and sockets), while one apartment requires 771 pieces. If there are 10 villas and 6 apartments, they will require 1930 and 4626 switches and sockets, respectively.

For construction level, if there are 10 villas:

- Four of them are under construction and, as a result of the field research survey, it will take six months for the products to be installed (therefore they require 193 * 4 = 772 pieces).
- For six other villas, whose construction level is complete, it will take three months for the products to be installed (and will require 6 * 193 = 1158 pieces).
- This equates to a market size of 1930. However, with more analysis, the market will require 1158 pieces after three months and 772 pieces after six months.
- This can be applied to all building types; by taking into consideration the construction level.

The study area was divided into small areas, with the aim of identifying growth of micro-geographic area levels and to better plan and guide logistic processes better and help government agencies and companies improve their services. The main road was selected as geographical boundaries and given unique numbers (Fig. 4). The following diagram explains the mechanism of work from the satellite image interpretation to calculate the market size.

5.1. Using Geospatial and Remote Sensing Data with Geomarketing Strategy and Determine Market Size

High-resolution satellite images were used to identify new buildings that were built after January 2016. The number identified was 4268, which were classified according to building type and construction level (see Table 1). Based on the new division of the study area, in each micro-geographic area, growth was determined using a geographic information system (GIS).

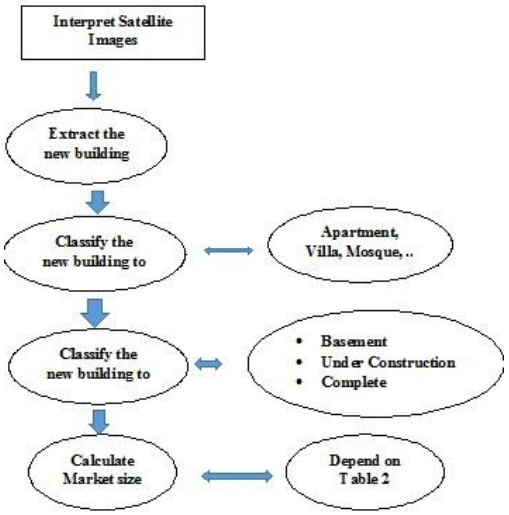


Fig. 4: Diagram illustrating the workflow

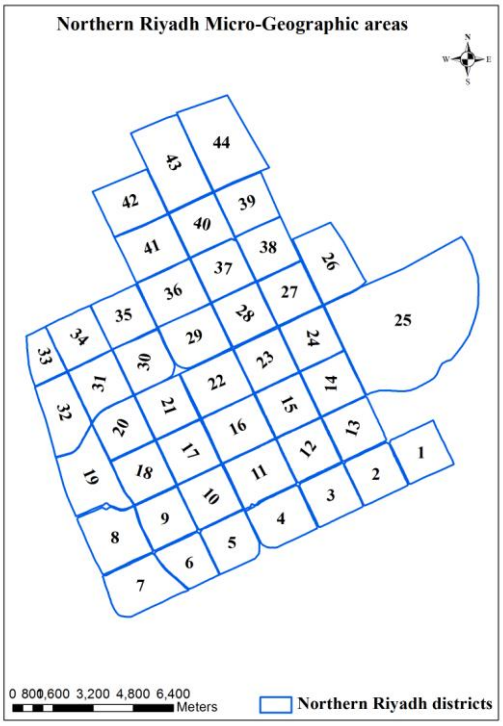


Fig. 5: North Riyadh micro-geographic areas (districts)

Identifying the number and type of new buildings in each micro-geographic area, and using Table 3, which explains the average number of switches and sockets needed by each building, we can calculate the market size in the study area (see Table 4). It is therefore possible to know the needs of each micro-geographic area for the products and their distributions. Figure 6 explains the market size at the micro-geographic area level, which uses GIS to convert the data to a visual map to identify the potential market size for each district.

Table 4: Total (switches and sockets) requirement for the new buildings

Buildings type	Switches Average	Number of Buildings	Products Quantities(piece)
Villa	193.66	3627	702410.1
Apartment	771.37	429	330918.5
Esteraha	48.63	57	2771.8
Mosque	104.67	15	1570
tower	4188.44	5	20942.2

Gas station	93.22	8	745.8
School	425.56	9	3830
Mall	227.25	1	227.3
Showroom	351.38	94	33029.7
Palace	425.56	18	7660
Warehouse	30	2	60
Governmental	1677.1	3	5031.3
		Sum	**1109197**

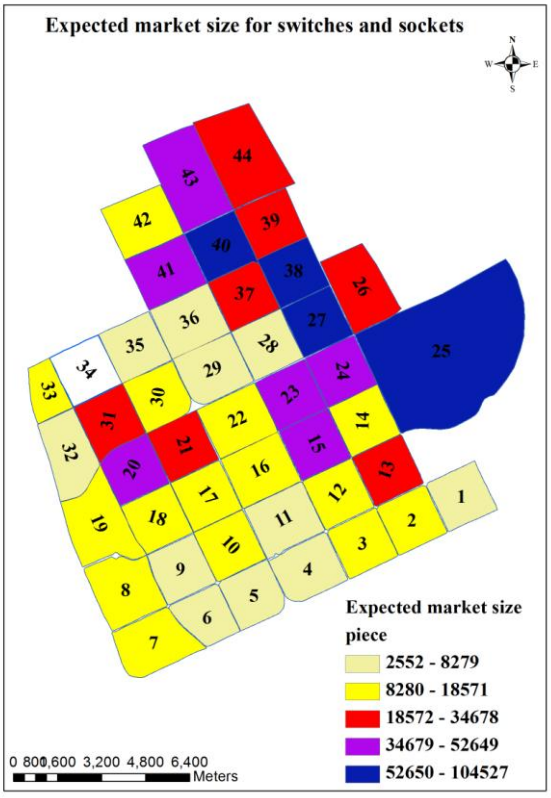


Fig. 6: North Riyadh micro-geographic areas (districts)

This map shows the highest market size at the district level with dark blue while the medium yellow is lowest market size

5.2. Calculate the Expected Market Size According to the Time:

Knowledge of market size is essential. Decision-makers can have a vision of the market situation and the amount of business they can contribute towards. However, the questions remain "how long will this take?" and "which areas can be an appropriate market?" As we know, building any construction requires an approximate time for when products can be installed. The time varies depending on building type, and in the case of the products that we are studying, a villa requires 1 year to install products from the basement. Meanwhile, if it is under construction, it will require six months and three months if the construction is completed.

Geomarketing and remote sensing provide a complete snapshot with the possibility of identifying the market size and an approximate time; after the satellite image has been analyzed and buildings have been classified for type and construction level using GIS. We will then know new buildings in each micro-geographic area with their construction level; building type and total number of products required in each district with approximate time (see Table 5).

For example, if we want to know the expected increase in market size after one year (starting October 2016) and the size of the change by micro-geographic area, GIS and Geomarketing can provide the necessary maps to understand the changes. Fig. 7 explains the new situation. This map shows the highest market size at the district level with dark blue while the medium yellow is lowest market size

Table 5: (Switches and sockets) expected market size growth according to the time

Total products (piece)	month				Grand Total
	3	6	12	24	
	445604	308586	287832	67173	1109197

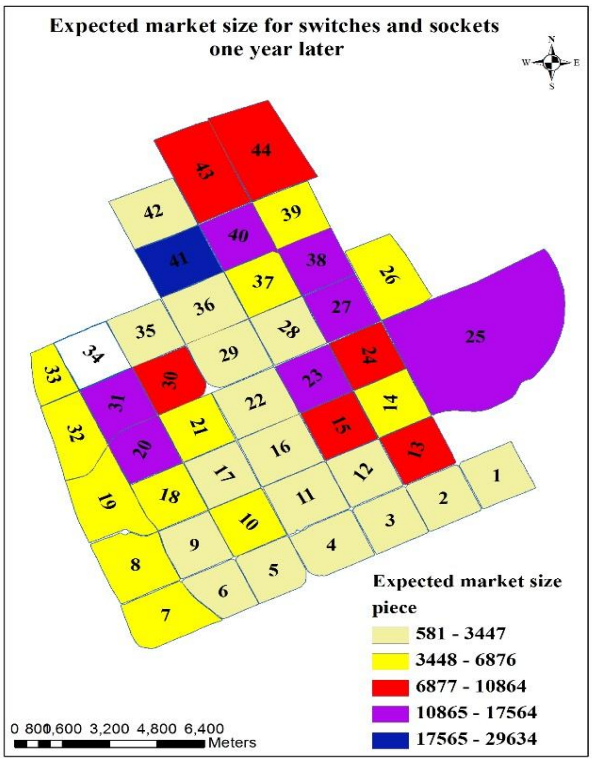


Fig. 7: the Increasing in Switches market size after one year

6. Conclusion

This research shows how we can use remote sensing technology in industry via planning, distribution and stock planning. In addition to government use, it can be used as important data for decision-makers, to improve the ability to prevent problems related to the inability to understand the current situation and anticipate the future.

It will be possible, at a later stage, to create a general vision for each city and therefore for entire regions or even the whole country; thus, enhancing the ability for comprehensive development and use of available resources at maximum capacity to prevent dissipation and loss or misuse of resources.

This methodology can extend to many other fields, such as FMCG and other material products. We can also use it in communications to determine where high data usage during the day to prevent sudden crashes.

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