TELKOMNIKA, Vol. 11, No. 9, September 2013, pp. 4878~4884
ISSN: 2302-4046

An Efficient Approach and Procedure to Solve Customer Complaints based on Combined Rasterization of Geography Information System

Qiang Chen*[1], Wei Guo[2], Sheng Jie Chen[3], Jin Li[4]
[*1,4]Department of Netwrok Management, Heilongjiang Co., Ltd. of China Mobile Group
No. 168, Xinwan Road, District of Songbei, Harbin, Heilongjiang, China, Ph./Fax:+86-451-58813506
[2]Computer Teaching and Research Center, Jilin University, No.142, Renmin Street,
Changchun, Iilin, China
[3]Co., Ltd. of Mide Technology, No.133, East Dazhi Street, District of Nangang, Harbin, Heilongjiang, China
*Corresponding author, e-mail: hlhlj@139.com[*1], guow@jlu.edu.cn[2]

Abstract

To solve customer complaints better for some telecommunication enterprises, a new method through combined rasterization of Geography Information System (GIS) is presented in this paper. By the combined rasterization of surface features and landforms, the historical customer complaints and the real-time state of network will be utilized to handle new complaints simultaneously. Also, an innovative process to handle complaints is proposed, too. The utilization of method and process will shorten the time of processing routine complaints. The experimental results show that the efficiency to process customer complaints will be improved greatly and the operation expenditure on customer services for telecommunication operators will be also decreased than before.

Keywords*: combined rasterization, customer complaints, GIS, telecommunication*

1. Introduction

With the development of communcation technologies and application of mobile services, the customers' requirement to mobile communication is increasing gradually. Meantime, the number and kinds of different services will be richer than before. For telecommunication operatos, higher service level will be required to provide all the customers. It is always the concern for many first class operators, e.g. AT&T, Verizon, Vodafone, China Mobile, how to handle customer complaints more efficiently, reduce the customer loss and improve the quality of customer serives. To some extent, this is the best expression of corporate social responsibility, too [1, 2].

To support the development of voice services and value-added services.To do so, an old question puzzled telecommnication operators continuously that the new complaints occurs with the network construction every time. We never deny that center of customer services will play an important role in the inner organization, which can promote the social image of enterprises and satisfaction of customers. That word, "Customer is First", is absolutely right. As a customer, if his complaint is solved by customer service calls directly, then other services of the company will be utilized and his loyalty to the company will be built easily [3-5].

Generally speaking, the aim to center of customer services for an enterprise is the efficiency and quality to solve customer conplaints; for telecommunicaiton operators, a uniform center of customer services is necessary, because kinds of complaints emerge with the development of services frequently. More importantly, the ratio of network quality to the total number of complaints is higher, it is required to bulid up a well-organized procedure, which will standardized complaints process through series of standard steps. As the process sketch shown in Figure 1, when a new complaint occurs, firstly, the complaint will be categorized based on the descripted content; secondly, complaints related to network quality wiil be pre-processed by the knowledge and experience, i.e., if the complaint can be solved, then the corresponding result will be given to the customer without the participation of department of background support; thirdly, when the complaint cannot be handled immediately, it will be transfered to the

Received January 29, 2013; Revised May 28, 2013; Accepted June 10, 2013

backgroud to be solved and the processed results will be re-transfered to the center of customer services [6-8].

The process to handle customer complaints for telecommunication operators is mainly implemented based on the key word described by customers; however, it is obvious that there are many disadvantages in this process, especially for complaints related to kinds of network quality, such as weak network coverage, call drop rate of different areas, traffic congestion rate etc [9-11]. The integration of current network information, performance index of historical network quality and historical customer complaints based on Geography Information System (GIS) will improve the efficiency and quality of complaints processing greatly. An innovative approach and procedure to handle customer complaints of network quality based on combined rasterization of GIS, which can promote the location efficiency of new complaints and make the same kind of rasters merged, historical and current network information utilized fully.

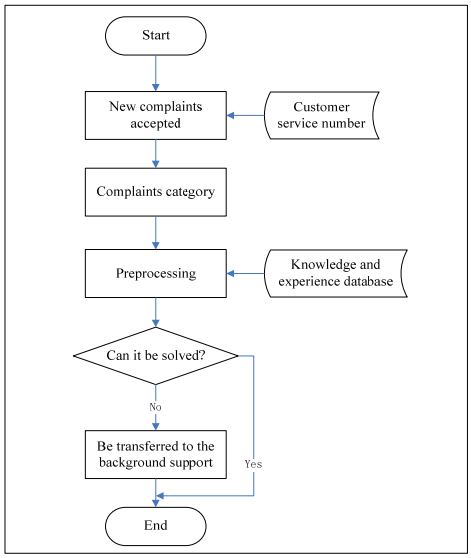

Figure 1. General Process of Handling Customer Complaints

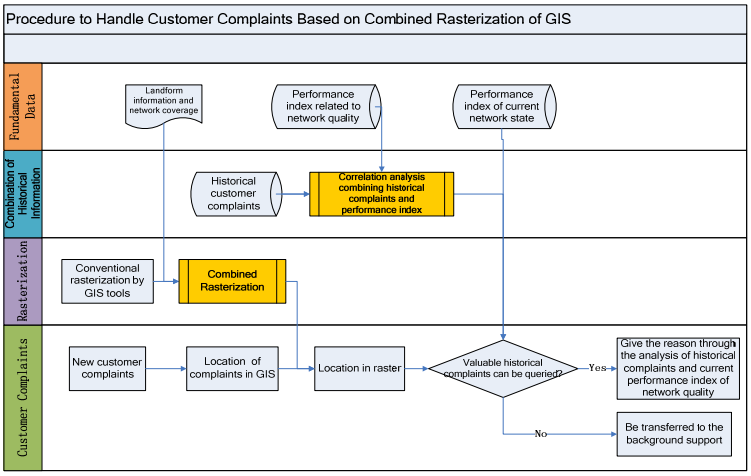

Figure 2. Flow Chart to Handle Customer Complaints based on Combined Rasterization

2. Research Method

As mentioned above, it is difficult to handle customer complaints relying on key words query from knowledge database for employees from center of customer service, which will

increase the time span to solve customer complaints and cannot satisfy customers' requirement directly. In addition, landforms of regional maps cannot be utilizaed fully in the method of conventional rasterization [12]; on one hand, there exists different performance index of network quality and landforms in one raster, on the other hand, there may exist the same performance index and landforms in different raster, which causes the inaccuracy of historical complaints acquired from rasters and cannot support customer complaints processsing effectively [13-16]. In this scetion, a new method of rasterization based on GIS and correlation between rasterization and performance index of network quality will be detailed.

The total procedure to handle customer complaints based on combined rasterization and correlation of historical complaints and performance index of network quality is described in Figure 2, in which some key models, such as conventional rasterizaion, combined rasterization, correlation analysis etc, are listed in the folw chart. Then, combined rasterization and correlation analysis based on historical complaints and performance index of network quality will be expressed in detail respectively [17].

2.1. New Method of Rasterization

The new method of combined rasterization is carried out on the basis of conventional rasterization. The operable steps in Figure 3 are detailed as follows:

Step 1: a fixed range is chosen and set as the length to divide the whole map into regular rasters, then fundamental and square rasters can be obtained wih the fixed range by GIS software, like ArcGIS or MapGIS.

Step 2: each raster wiil be labelled by the property of landform and surface feature in this step. The fundamental rasters are classfied into different types based on landform information, such as mountains, rivers and forests etc, then the rasters with the same type landform will be subdivided combined with culture feature, like residental area, street, green area, shopping cente etc.

Step 3: the labelled rasters from Step 1 and Step 2 will be merged according to the neighbourhood type, in which irregular rasters can be calculated.

Step 4: the irregular rasters will be subdivided on the basis of network coverage further to irregular region rasters, which can build up the ability to locate the position of customer complaints precisely and extract historical complaints information from rasters accurately.

2.2. Correlation Analysis between Rasterization and Performance Index of Network Quality

The correlation analysis based on rasters from the combined rasterization and running state of network expressed by performance index is implemented. To do so, the location efficiency and precision of complaints based on rasters of GIS can be enhanced than ever, which will be proved by the experimental results in Section 3. The operable steps in Figure 4 are listed as follows:

Step 1: the raster corresponding to the description of new complaints will be located, from which historical complaints will be extracted and then these historical complaints are to be combined with performance index of network quality when historical complaints happened dynamically.

Step 2: current performance index of network quality in the located raster above will be matched with the running state of network when historical complaints happened, then an array of historical complaints close to the running state of network when the new complaints happend can be obtained.

Step 3: the explanation to obtained historical complaints will be the reference to new customer complaints, which can be utilized by employees from center of customer service directly; if historical complaints cannot be obtained, then the complaints will be transferred to the background support.

3. Results and Analysis

In this section, the algorithms to implement the combined rasterization and correlation analysis between historical complaints, running state of network and current network performance index and the simulation results will be given together.

It should be noticed that all service information and statistical data cited here are provided by Heilongjiang Co., Ltd. of China Mobile Communication Corporations. As we all known, in addition to basic voice service, many value-added services become the new profit source for telecommunication operator. For any operator, customer service number plays double role on the complaints and consultation for customers. In Table 1, in which the data are chosen randomly from one week of June in 2011, it can be seen that top seven services close to network quality directly are voice service, WLAN service, GPRS service, etc and the number of complaints (NoC) is beyond the number of complaints handled directyly (NoC-HD), which also means that much workload will be transferred to the background supprt. To satisfy the requirement of complaints for different customers, an efficient process to handle customer complaints should be set up.

The algorithms of postionning and merging rasters with the same type and correlation analysis based on historical complaints, historical performance index and current performance index of network quality are shown in Figure 5 and 6, which are given by Python Script Language and pseudocode with C Language, respectively. In this section, the statistical data are sampled from the database of Supporting System of Customer Complaints from January to December in 2012.

3.1. Comparison of New Combined Rasterization to the Conventional One

In contrast to cnventional rasterization of GIS, in which the whole map will be divided into many square rasters with fixed length automatically and the relationship between landform and performance index of network quality cannot be utilized fully, the combined rasterization will increase the precision of locating the customer complaints considering the landform and surface features and improve the efficiency greatly.

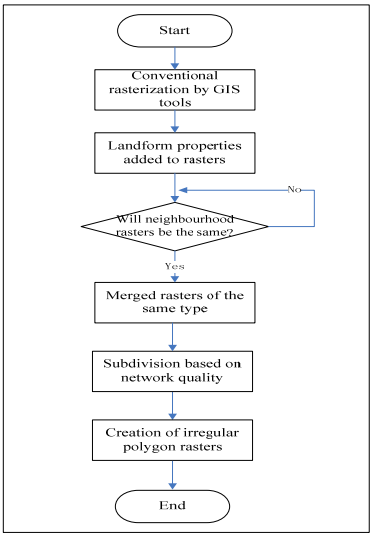

Figure 3. Calculation of Irregular Polygon Rasters based on GIS

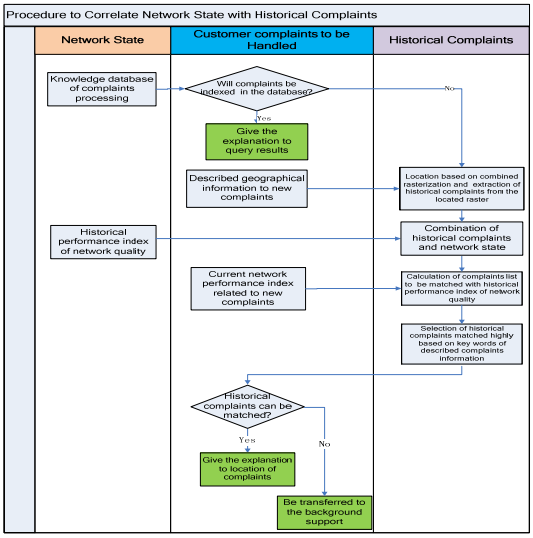

Figure 4. Correlation Analysis between Historical Complaints and Running State of Network

Table 1. The Types of Services Close to Network Quality

Service types	The number of complaints handled directlly	The number of complaints
Voice service	37	436
WLAN service	76	531
GPRS service	31	99
Mobile newspaper	55	935
Blackberry mailbox	55	216
Short message service	49	297
Mobile securities service	43	233

```
# operation model of system called
import  os
import  arcpy
files = os.listdir(Catalog_of_raster)
running =True
while running:
      i_flag=0
      str_fileflag=""
      str_filename=""

      for  f in files:
            if (i_flag==0):
                  str_fileflag=f[:5]
                  str_filename=f
                  i_flag=1
                  continue
            stmp=f[:5]
            if (str_fileflag==stmp):
                  arcpy.MosaicToNewRaster_management("f;str_filename",
                  Catalog_of_raster, stmp plus "Name_of_merged_raster",
                  "Coordinate", "Raster_layer", "Cellsize",
                  "Number_of_bands", "LAST", "FIRST")
#merged raster files removed to a new catalog
                   os.rename（f，New_catalog_of_raster_plus_raster X）
                  if (i_flag==1):
                        os.rename（str_filename，New_catalog_of_raster_plus _raster Y）
                        i_flag=2
                  str_filename=stmp+"Name_of_merged_raster"

#when loop ends, rasters will be removed to a new catalog
      os.rename（str_filename，Catalog_of_merged_raster_plus_raster Y）
      if  os.listdir(Catalog_of_raster):
            files = os.listdir(Catalog_of_raster)
      else
            running =False
```

Figure 5. Algorithm of Combined Rasterization based on GIS

```
void main( )
{
//parameters definition to postioin of new complaints, current performance index
      string str_site;
      string str_type;
      string str_performance
      string str_alarm_info;
      float[ ] f_raster_site=get_raster_position(str_site);
//correlation analysis to position of raster, types of complaints and performance index
      string alarm_history=get_history_alarm_info(f_raster_site,str_type,str_performance,
      str_alarm_info);
      if (alarm_history!="")
      {
            return_alarm_reason(alarm_history);
      }
      else
      {
            send_work_order();
      }
}
//available historical complaints query
private string get_history_alarm_info(float[ ] f_raster_site,string str_type,string str_performance, string str_alarm_info)
{
      string str_info=get_complaint_repository(f_raster_site,str_type,str_performance);
      if (str_info!="")
      {
            return str_info;
      }
      else
      {
//position of customer complaints and extraction of historical complaints from positoned raster
            DataTable dt_history_complaint=get_history_complaint(f_raster_site);
            DataTable dt_history_performance=get_history_performance(str_performance);
//an array of complaints matched with historical complaints
            DataTable dt_dispose=dispose_info(dt_history_complaint, dt_history_performance);
            foreach ( DataRow row_info in dt_dispose )
            {
                  if (rowinfo[field]==str_alarm_info)
                  {
                    return rowinfo[field];
                  }
            }
            save_new_complain_repository(str_alarm_info);
            return "";
      }
}
```

Figure 6. Pseudocode of Correlation Analysis based on Combined Rasterization

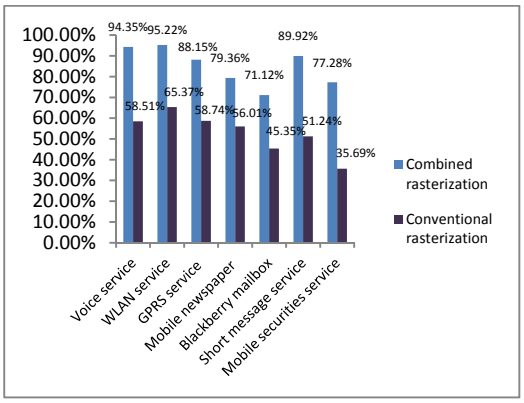

Figure 7. Precision of Locating the Customer Complaints

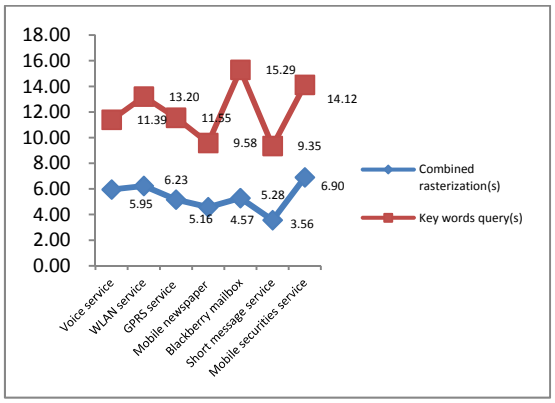

Figure 8. Comparison of Average Consuming Time of Location to Key Words Query

It should be pointed out that the precision of locating customer complaints amounts to 94.35% for voice service and 95.22% for WLAN service in Figure 7, in which the precision means not only the geographical position, but also the precision related to the running state of network and it also shows that employees from center of customer service can locate the place where customer complaints happened easily and conveniently through the combined rasterizatioin. .

In Figure 8, the contrast of consuming time based on the combined rasterization and key words query according to the information described by customers is shown. We can see that consuming time to locate the position of customer complaints in contrast to key words query by adopting the approach of combined rasterizatioin, especially for Blackberry mailbox service, its average consuming time decreases from 15.29 seconds to 5.28 seconds.

3.2. Results of Customer Complaints Handled Directly

Expeimental results show that the efficiency to handle customer complaints based on combined rasterization of GIS is highly improved. Which includes voice service, GPRS service,

WLAN service and short message service mainly. It can be seen that the highest ratio of NoC-HD to NoC is 75.95%, 64.13%, 84.32% and 81.44% in Figure 9, Figure 10, Figure 11 and Figure 12, respectively. Moreover, the average ratio of NoC-HD to NoC in Figure 11 is from 66.80% to 84.32%, which also shows that many customer complaints of WLAN service can be handled directly than other services.

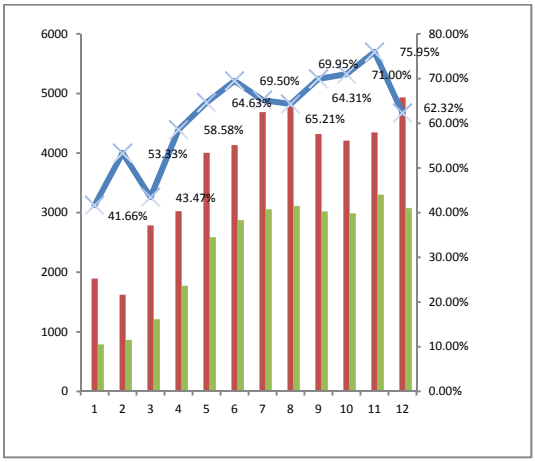

Figure 9. The Proportion of NoC-HD to NoC for Voice Service

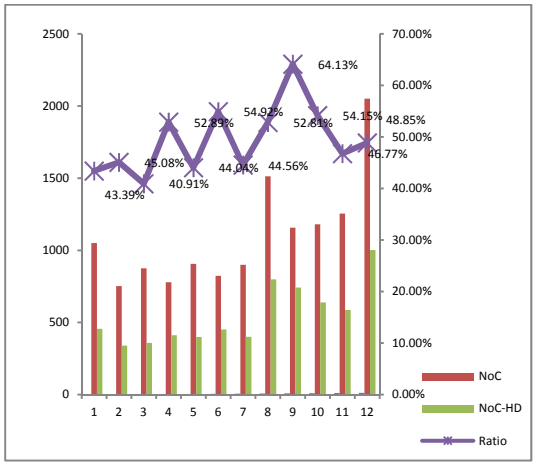

Figure 10. The Proportion of NoC-HD to NoC for GPRS Service

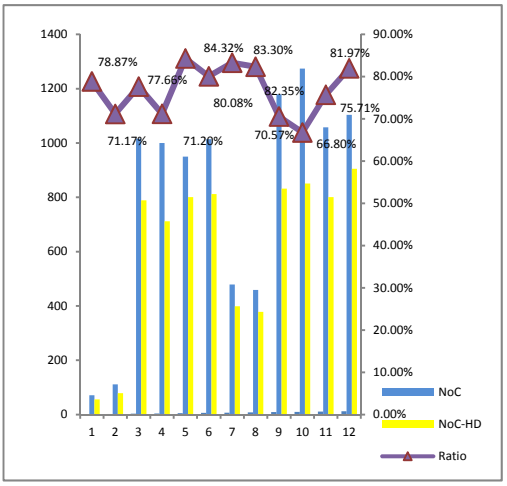

Figure 11. The Proportion of NoC-HD to NoC for WLAN Service

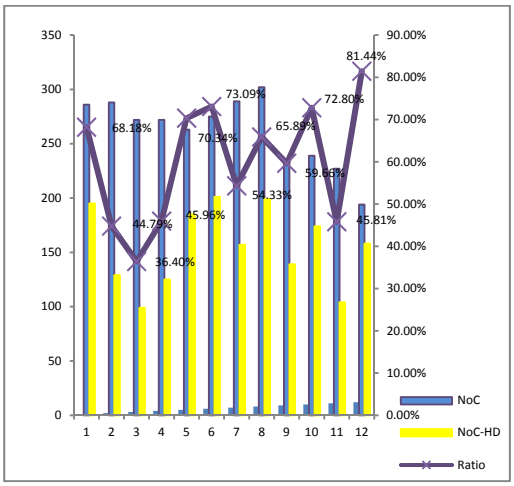

Figure 12. The Proportion of NoC-HD to NoC for Short Message Service

Based on the experimental results, if the approach presented in this paper will be applied to Supporting System of Customer Complaints for a telecommunication operator, then the efficiency to solve customer complaints will be increased, which decrease some unnecessary workload from center of customer service to department of network maintenance and routine operation expenditure.

4. Conclusion

A new combined rasterization on the basis of conventional rasterization and procedure to handle customer complaints is proposed in this paper, which can be adopted to handle customer services by any telecommunicaiton operator. When new complaints happen, historical complaints can be extracted from the located raster and combined with performance index of

network quality when these historical complaints happened, and then the optional historical complaints set with network running state and complaints decription will be obtained. Historical complaints close to current network running state will be drawn through matching with elements of the set, and the explanation according to the key words of complaints content described by customers will be given to customers. As the experimental results show, the effiency of location and solution to new complaints will be higher than ever; simultaneously, this scheme expounded in this paper will help telecommunication operators to decrease some unnecessary interactive links from center of customer service to the background support, cut down the operation expenditure on the training of employees from center of customer service.

References

[1] Valane A Zeithaml, Leonard L Berry, A Parasuraman. The Behavioral Consequences of Service Quality. *Journal of Marketing*. 1996; 60(2): 31-46

[2] Stephen S Tax, Stephen W Brown, Murali Chandrashekaran. Customer Evaluations of Service Complaint Experiences: Implications for Relationship Marketing. *Journal of Marketing*. 1998; 62(2): 60-76

[3] Christian Homburg, Andreas Furst. How Organizational Complaint Handling Drives Customer Loyalty: An Analysis of the Mechanistic and the Organic Approach. *Journal of Marketing*. 2005; 69(3): 95-114

[4] James G MaxhamIII, Richard G Netemeyer. Modeling Customer Perceptions of Complaint Handling over Time: the Effects of Perceived Justice on Satisfaction and Intent. *Journal of Retailing*. 2002; 78: 239-225

[5] Gardial, Sarah FD Scott Clemons, Robert B Woodruff et al. Comparing Consumers' Recall of Prepurchase and Postpurchase Product Evaluation Experiences. *Journal of Consumer Research*. 1994; 20: 548–560

[6] Cox M, Hanrahan P. Pixel Merging for Object-Parallel Rendering: a Distributed Snooping Algorithm. *Symposiumon Parallel Rendering ACM SIGGRAPH*. 1993: 49-56

[7] Robert J Hijmans, Susan E Cameron, et al. Very High Resolution Interpolated Climate Surfaces for Global Land Areas. *International Journal of Climatology*. 2005; 25: 1965-1978

[8] Kazhdan M, Hoppe H. *Streaming Multigrid for Gradient-domain Operations on Large Images*. Proceedings of the ACM Trans. Graph (SIGGRAPH2008). 2008; 27: 1-10

[9] T Brinkhoff, HP Kriegel, R Schneider, B Seeger. *Multi-step Processing of Spatial Joins*. Proceedings of the ACMSIGMOD Conference. 1994: 197-208

[10] Lathrop O, Kirk D, Voorhies D. Accurate Rendering by Subpixel Addressing. *IEEE Computer Graphics and Applications*. 1990; 10(5): 45–53.

[11] Ineda J. *A Parallel Algorithm for Polygon Rasterization*. Proceedings of ACM SIGGRAPH 88). 1988; 17-20

[12] Atkinson PM. Optimal Sampling Strategies for Raster-based Geographical Information Systems. *Glob. Ecol. Bio-geogr. Lett.* 1996: 5: 271–280

[13] Athrop O, Kirk D, Voorhies D. Accurate Rendering by Subpixel Addressing. *IEEE Computer Graphics and Applications*. 1990; 10(5): 45-53

[14] R Guida, A Iodice, D Riccio, U Stilla. Model-based Interpretation of High-resolution SAR Images of Buildings. *IEEE J. Sel.Topics Appl. Earth Observ. Remote Sens*. 2008; (2): 107-119

[15] Abdelilah Azyat, Naoufal Raissouni, Nizar Ben Achhab, Mohamad Lahraoua, Asaad Chahboun. Mobile Geographic Information System Platform (MGISP): A GPS Information Collection System, *International Journal of Information & Network Security.* 2012; 1(2): 140-151

[16] Myint MyintSein, Thin Lai LaiThein. Synthesizing the Whole View of a Large-Scale Object. *International Journal of Informatics and Communication Technology*. 2012; 1(1): 20-25

[17] Qiang Chen, Jiang Yu, Y. Hong Wu et al. *Processing Method, Device of GIS Rasterization and Processing Method, System of Customer Complaints*. CN201210584652.5 (Patent). 2012.