International Journal of Database Theory and Application
Vol.9, No.10 (2016), pp.295-304
http://dx.doi.org/10.14257/ijdta.2016.9.10.25

Application of Multidimensional Data Analysis in Power Marketing Decision Support System Based on Big Data

Sun Zhineng, Yu Fang, Zhou Kaihe, Li Jiangang and Fang Yunhui*

Ningbo power supply company of State network Zhejiang Electric Power Corporation, Ningbo 315007
**Address correspondence to Fang Yunhui, email: fangyunhui1@163.com*

Abstract

With the establishment of the power system in depth and marketing system, the power supply enterprise marketing has become a core business, develop marketing strategies to adapt to market is very important to develop efficient power marketing strategy needs to support comprehensive information. Multidimensional data analysis huge amounts of data and complex multi-angle, multi-level analysis and presentation, to obtain useful information hidden from the general to allow users to fully grasp the local business operation of multidimensional data analysis of historical data for the enterprise multi-angle, multi-level flexible as observed with high efficiency in the enterprise's existing historical data into useful information on. based on the multidimensional data analysis technology to build electric power marketing decision-oriented application of data analysis platform, through the companies have historical data analysis for the enterprise many policy-makers useful information.

Keywords: *Security management; Distributed power; microgrid operation control; mode change*

1. Introduction

How to Improve Power Marketing has become a major issue facing today's power companies, the quality of marketing efforts will directly affect the survival and development of power enterprises [1-3]. Power Enterprise decision-makers must be able to demand changes in the electricity market, in time to capture attractive market opportunities, flexible configuration of power marketing resources [4]. Through appropriate power product strategy, channel strategy electricity, power marketing strategy and pricing power to meet the electricity needs of the consumer market [5]. Thus, in the past the kind of simple and extensive pure power management has been far from meeting the requirements of market economy, we must make use of information technology and other emerging technologies to build electric power marketing decision support system under the market economy, to provide a strong, modern marketing technical support measures, strengthen supervision and management level, improve the competitiveness of enterprises, market and customer focus, to facilitate the customers for the purpose, to create new ways of service, the maximum increase enterprise efficiency [6-7].

So far, computer applications in the power industry in information technology can be divided into three stages [8-11]. The first stage in the initial period of the power of information technology, mainly was used in electric power experimental basis [12]. The engineering technical has computing automatic monitoring of power plants, substation automatic monitoring [13-14]. Its main objective is to improve the automation of power plants and substations of the production process, improve production and electricity transmission and distribution of surveillance, improve project design and calculation speed, shorten the design cycle power engineering *etc.* [15-18]. this period information technology is mainly used in scientific computing and engineering operations, belong to

ISSN: 2005-4270 IJDTA

the second phase of special business application stage "computer system has been applied, the electric power industry widely used computer systems, such as dispatching automation, power plants in the majority of business in the power industry automation control systems, power control load forecasting, computer-aided design, computer simulation of power systems [19-20].

In this paper, we learn and master multi-dimensional data modeling, multidimensional data analysis, multidimensional data analysis application implementation, according to the power supply situation and marketing information business user features, choose the right platform for multidimensional data analysis tools for electric power marketing decision multidimensional data analysis applied research. Power marketing business data analysis system includes a source layer, data layer, multidimensional data analysis layer, application layer, determine the function of each layer, implementation. Put forward the overall design of electric power marketing decision support system to complete its operating environment software and hardware design, performed data conversion polymerization subsystem, statistical reporting subsystem, an integrated query subsystem and four-part comprehensive analysis of the subsystem design.

2. Power Marketing Data Analysis

2.1 Power Marketing Multidimensional Data Analysis Process

Multidimensional data analysis technique is an efficient data analysis technique, many enterprise data analysis applications have been successful, there have been many multidimensional data analysis development platform [21]. Based on multidimensional data analysis technology to build power marketing data analysis platform for enterprises already have historical data multifaceted, multi-level analysis, provide a lot of useful information for the power marketing decision-makers' power marketing decision relating to data analysis as shown in Table 1.

Table 1. Power Marketing Decision Relating to Data Analysis

A theme	Two themes
Customer Analysis	Customers and households change analysis, customer capacity and change analysis, customer mix situation analysis, customer service analysis
Purchasing Analysis	Sources of structural changes of the purchase of electricity, purchase and sale of electricity gap analysis
Electricity sales analysis	Electricity sales to complete the analysis, structural changes in electricity sales analysis, changes in electricity sales and influencing factors analysis, large customer electricity sales and contribution analysis, time analysis of electricity
Price Analysis	The average price of the completion of the analysis, the average price change analysis, the effect of the implementation of tariff policy analysis, the average price of electricity sales market analysis
Analysis of income from electricity sales	Electricity sales revenue analysis, income from electricity sales structure and change analysis, influencing factors income from electricity sales, electricity and large customer contribution analysis, time analysis of electricity
Tariff Recovery Analysis	Electricity will search the overall situation analysis, customer analysis large arrears, bad debts arrears analysis, industry analysis arrears
Analysis of equipment assets	Overall equipment assets analysis, operation analysis equipment

Electricity inspection Analysis	Electricity inspection isolated violations analysis, measurement analysis of abnormal electricity analysis of census
Marketing Quality Analysis	Marketing staff performance evaluation analysis, job analysis

Power Marketing Decision for power marketing data analysis required by topic. Each topic corresponds to a specific analysis, information on behalf of a class of power marketing decision-makers need. According electricity power marketing business characteristics of the electric power marketing decision relating to data analysis into customer analysis, purchase analysis, electricity sales analysis, price analysis, income from electricity sales analysis, tariff recovery analysis, asset analysis, electricity check the situation analysis, marketing, quality analysis and other topics, and topics are further subdivided large subtopics.

Different risk transfer power system problems which passes structure is not the same, but the removal of the contents of its surface to extract the contents of the trunk, the risk element transfer mode can be attributed to relational, hierarchical, tree, network type, Pei mixed type, *etc.*, which the most basic element of risk transfer structure is relational, but also in other important transfer unit structure. Relational transfer mode element constitute two risk is the risk element transfer mode is the most simple, basic transfer mode. Therefore, the relational transfer mode consists of two risk element is composed of the atomic structure of the entire risk element transfer mode, the transfer theory to understand the atomic structure and its mathematical foundation helps to understand the entire risk element transmission theory.

2.2. Data Mining and Neural Networks Model

To solve the problem of multiple logical combination of conditions, the user needs to set the intensity of the intention of the relevant description and model libraries. As shown in equation 1:

$$m_i = \frac{\sum_{j=1}^{J}\sum_{l=1}^{L} p_l * Z_j * G_{ji}}{\sum_{j=1}^{J} G_{ji}} \quad (1)$$

Where m is the relevance of decision-making model; pi each atom of the conditions set by the user's own decision-making intention proportion (subjective factor factor); zj conditions for the atomic model of the main features of the relevant degree; Gij main features of the model and the model of relevance.

To accomplish this objective, we must analyze the existing data in the electricity marketing data warehouse from which to discover and extract hidden information or knowledge therein. This process is the data mining process, the goal is to help analysts find links between the data elements found to be ignored, to predict trends and dig out useful information for decision-making behavior. General data mining process was shown in Figure 1.

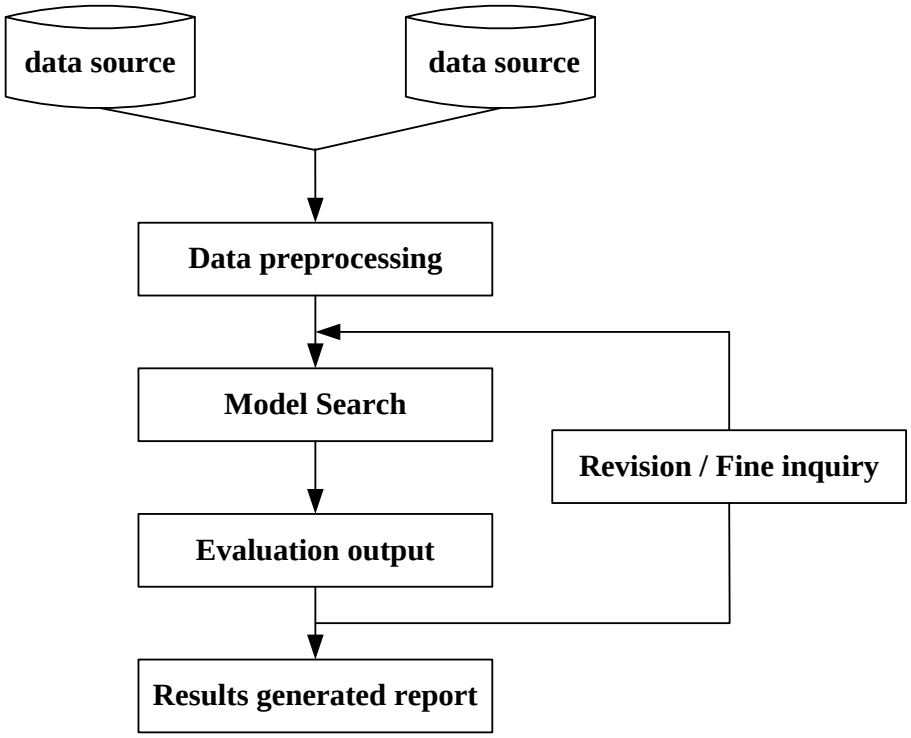

Figure 1. General Data Mining Process

Electricity demand forecasting first problem to be solved is the realization of nonlinear mapping, artificial neural network has some advantages in this regard. Under normal circumstances, assuming that the requirements of non-linear mapping study of formula (2):

$$y = f(x), x = (x_1, x_2, \cdots, x_n) \tag{2}$$

On the domain clustering R subset R of a multi-input single-output real continuous function, its sample data is as follows:

$$x(k) \to y(k), k = 1, 2, \cdots s \tag{3}$$

$$y = \sum_{t=0}^{m} \theta_t \phi_t (\| x - c_t \|) + e \tag{4}$$

Defined error function Y (m) formula:

$$Jm = \frac{1}{2} \sum_{k=1}^{s} (\bar{y}(k) - y(k))^2 \tag{5}$$

Wherein, y (k) is the output sample point, y (k) is the network output. It can be shown when the selected function systems:

$$\{\phi \| x - c_i \|\} (0 \le i \le m) \tag{6}$$

By increasing the number of hidden units, to achieve the continuous improvement of the fitting precision, so that the rate of error of less than a given purpose. However, in practice, if m is made too large, it may cause pathological appear redundant and numerical models, and therefore must take effective methods to determine and select the network weights hubs. In this paper, orthogonal least squares method selected center hidden layer node basis functions. The advantage of this approach is to select the best of the sample point as the center.

3. Experiments and Results

3.1. Design of System Architecture

Need to build a data warehouse, according to the data demand of each theme, the establishment of subject-oriented data storage model, migration in the enterprise database systems from existing business data corresponding to the data layer of the data warehouse. Data layers required for each topic for data storage, in order to multidimensional data analysis layer to provide efficient, consistent, stable and oriented analysis of data. The system uses the relational database products, data storage according to the data demand of electric power marketing decision each topic to provide data directly to the multidimensional data analysis layer. Database platform not only has a large-capacity data storage capacity to support multi-user concurrent operation, but also has a strong data query capabilities. Power marketing analysis system structure was shown in Figure 2.

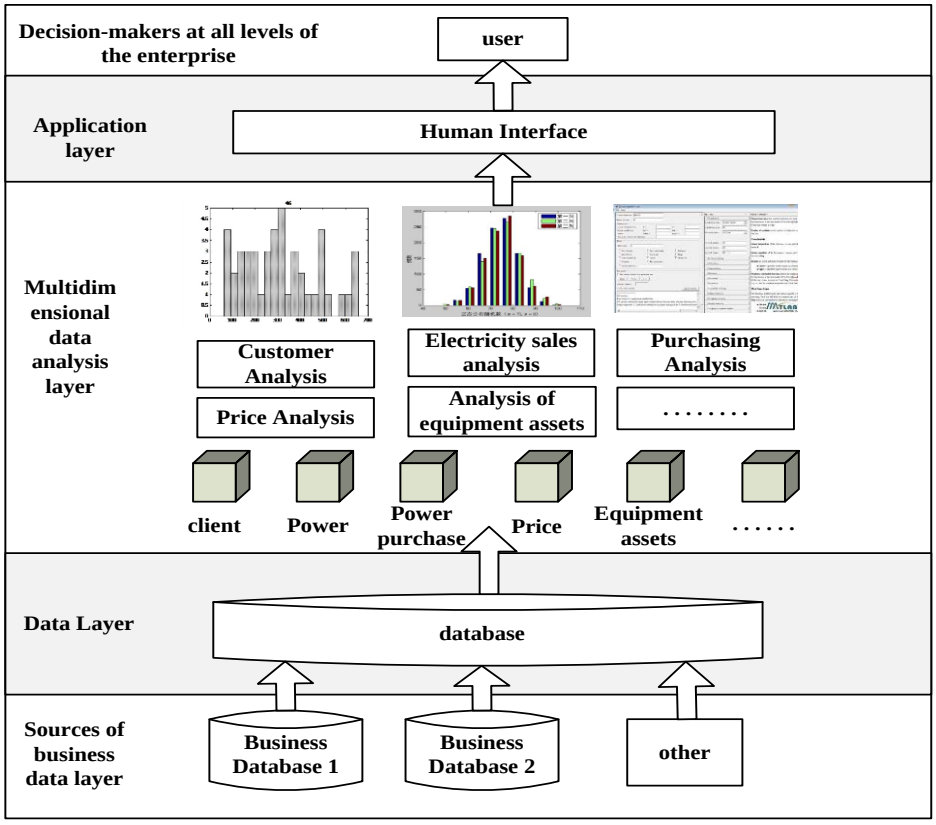

Figure 2. Power Marketing Analysis System Structure

Construction of power marketing analysis system requires the data layer to enterprise data sources historical business data services layer, based on the need to re-design database storage mode according to the electric power marketing decision relating to data analysis data analysis to achieve analytical data reconstruction, or by directly existing business database view to achieve the establishment of analytical data reconstruction.

3.2. Design Multidimensional Data Analysis Capabilities

After the multi-dimensional data modeling, data analysis requires electric power marketing decision based on the theme of historical analysis of enterprise data to analyze each topic application of multidimensional data, obtain useful information for decision-

makers. First, historical data relating to the realization of all cut or sliced, electric power business organization is hierarchical management, decision-makers at all levels of the corresponding levels and subordinate enterprise historical data multidimensional data analysis from which to obtain useful information. Every analysis of historical data without the use of a database system for all time, policy makers tend to focus on the historical data of a certain period of time. When multidimensional data analysis, it must first provide a business organization dimension and time dimension of the cut or slice function, in addition to the need to provide policy-makers need to cut or slice the functionality of other dimension.

Due to limitations of computer data representations of multidimensional data analysis commonly used in the chart are two-dimensional or three-dimensional charts. For 2D charts usually put dimensions in the X-axis, Y-axis put the measure for 3D charts usually put dimensions in the X-axis and Y-axis, Z-axis put the measure. For more dimensional analysis needs, we need to select some dimension to slice or dice, to convert it into two or three dimensional analysis. Structural changes such as electricity sales analysis, the use of three-dimensional graph to analyze certain changes in electricity sales over time; the use of two-dimensional pie chart analysis of the composition of certain portion of electricity sales, to identify the main components; a three-dimensional histogram analysis of changes in the composition of certain electricity sales occurred over time. In summary, the analysis of the power marketing system the basic framework for multidimensional data analysis was shown in Figure 3, policy makers to select objects from the left side of the cube model based on the need for data filtering analysis table or chart analysis.

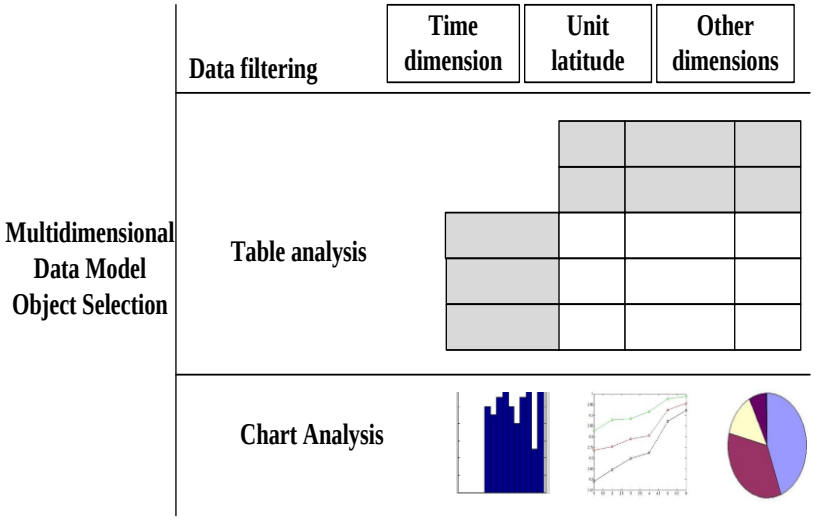

Figure 3. Power Marketing Analysis System for Multidimensional Data Analysis Framework

For users with multi-dimensional data analysis and multidimensional data analysis provides a powerful analytical support rotation, on the same topic after the application of multidimensional data analysis to analyze the data obtained may have multiple views, different users may require different views of the data. Power marketing analysis system based on user needs, and to provide multi-dimensional data to each user-defined analysis of the final view.

By decision support system factors and costs associated with the analysis, we can conclude the decision-making power marketing analysis information flow diagram, as shown in Figure 4.

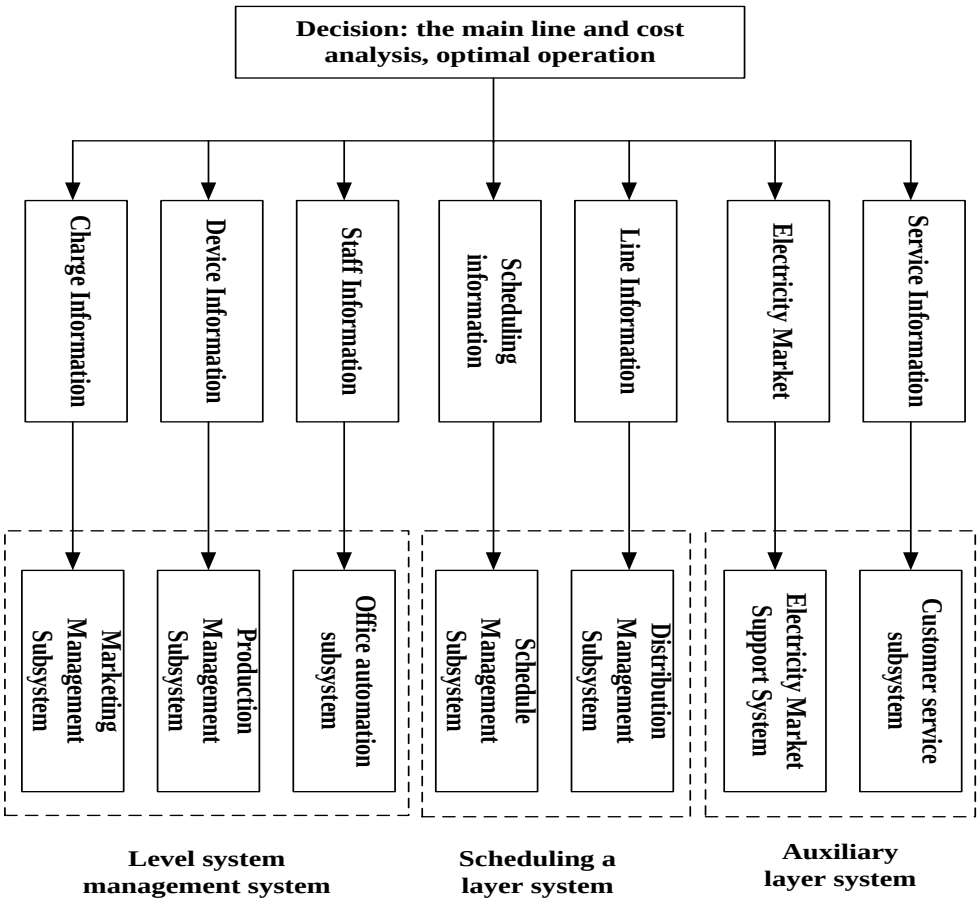

Figure 4. Power Marketing Decision Support Information Flow Diagram

3.3 Power Marketing Analysis System Integration

Based on the analysis of multidimensional data analysis technology to build power marketing system, used in electric power marketing decisions, provided various information. Power marketing analysis system based on multidimensional data analysis techniques on JZEE platform integration shown in Figure 5, the multidimensional data analysis staff on Businessobjectsxl platform for various electric power marketing decision relating to multidimensional data analysis to achieve further development of power marketing system platform by JZEE web site users integrate applications, the platform on Businessobjeets multidimensional data analysis information in the form of web pages available to decision-makers at all levels of power marketing business.

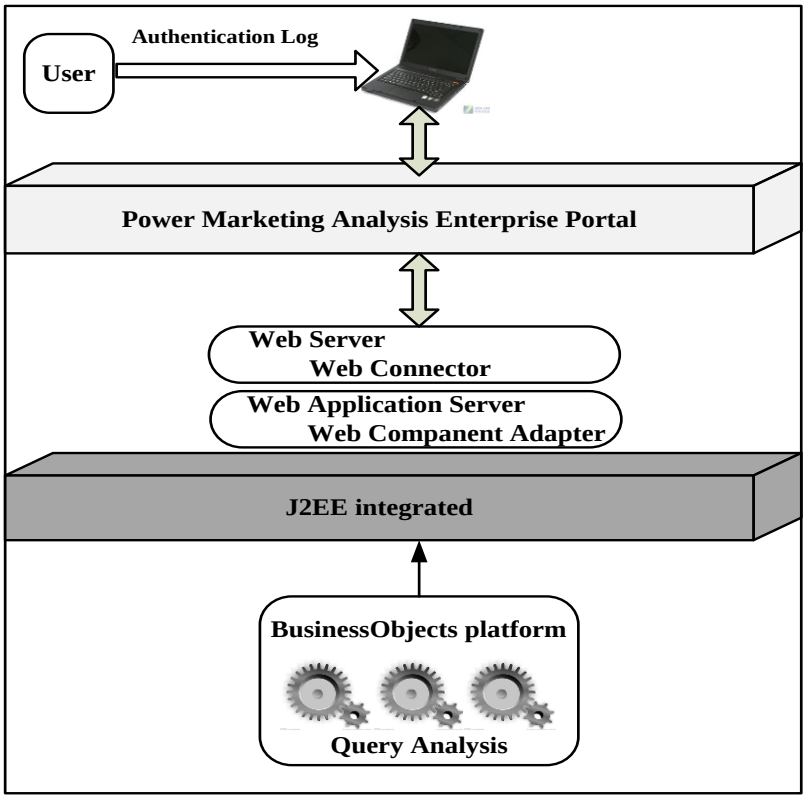

Figure 5. Power Marketing Analysis System Based on Multidimensional Data Analysis

Multidimensional data analysis in BusinessobjectsXl platform by establishing for each electric power marketing decisions relating to the query and analysis documents (Weblntelligenee document) implementation. Query and analysis document is saved Businessobjeetsxl platform repository, power marketing analysis system needs to access through BOE them, BOE is BusinessobjeetsXl platform integrated management platform, import/export, publish, designer, Central Configuration Manager and other internet tools to manage . BOE platform provides two ways for users to access JZEE integration: SDK manner and URL mode, SDK mode allows users to view the information according to their characteristics defined way information is organized, refresh mode information and the like.

4. Conclusion

Power Marketing System and other enterprise marketing systems, facing the environment is complex, and therefore about the power marketing decision support system is a semi-structured decision support system category. Multidimensional data analysis huge amounts of data and complex multi-angle, multi-level analysis and presentation, to obtain useful information hidden from the general to allow users to fully grasp the local business operation of multidimensional data analysis of historical data for the enterprise multi-angle, multi-level flexible as observed with high efficiency in the enterprise's existing historical data into useful information on. based on the multidimensional data analysis technology to build electric power marketing decision-oriented application of data analysis platform, through the companies have historical data analysis for the enterprise many policy-makers useful information.

References

[1] M. S. Manikandan, S. R. Samantara and I. Kamwa, "Simultaneous denoising and compression of power system disturbances using sparse representation on overcomplete hybrid dictionaries", Generation, Transmission & Distribution, IET, vol. 9, no. 11, **(2015)**, pp. 1077-1088.
[2] D. H. Pham, G. Hunter, L. Li and J. Zhu, "Advanced microgrid power control through grid-connected inverters", In Power and Energy Engineering Conference (APPEEC), 2015 IEEE PES Asia-Pacific, IEEE, **(2015)**, pp. 1-6.
[3] Z. Zhu, J. Tang, S. Lambotharan, W. H. Chin, and Z. Fan, "An integer linear programming based optimization for home demand-side management in smart grid", In Innovative Smart Grid Technologies (ISGT), 2012 IEEE PES, IEEE, **(2012)**, pp. 1-5.
[4] F. Shariatzadeh, P. Mandal and A. K. Srivastava, "Demand response for sustainable energy systems: A review, application and implementation strategy", Renewable and Sustainable Energy Reviews, vol. 45, **(2015)**, pp. 343-350.
[5] Q. H. Spencer, A. L. Swindlehurst and M. Haardt. "Zero-Forcing Methods for Downlink Spatial Multiplexing in Multiuser MIMO Channel", IEEE Transactions on Signal Processing, vol. 52, no. 2, **(2004)**, pp. 461-471.
[6] M. Sadek, A. Tarighat and A. H. Sayed, "A Leakage-based Precoding Scheme for Downlink multi-user MIMO Channels", IEEE Transactions on Wireless Communications, vol. 26, no. 8, **(2008)**, pp. 1505-1515.
[7] J.van de Beek, O. Edfors, M. Sandell, S. Wilson and P. Borjesson, "On Channel Estimation in OFDM System", in Proceedings of the IEEE Vehicular Technology Conference, **(1995)**, pp. 815-819.
[8] M. R. Kotecha, and A. M. Kothari, "Performance Enhancement of image compression using SVD and Arithmetic Coding", International Journal, vol. 3, no. 10, **(2015)**.
[9] K. Wong, R. Cheng, K. B. Letaeif and R. D. Murch, "Adaptive antennas at the mobile and base stations in an OFDM/TDMA system", IEEE Transactions on Communications, vol. 49, no. 1, **(2001)**, pp. 195-206.
[10] M. Sadek, A. Tarighat and A. H. Sayed, "Active Antenna Selection in multi-user MIMO Communications", IEEE Transactions on Signal Processing, vol. 55, no. 4, **(2007)**, pp. 1498-1510.
[11] Z. Yazhou, Z. Guoxin, R. Yun and L. Mingqi, "A Novel Distributed Precoding Scheme Based on THP for Downlink Multi-Cell Multi-User OFDMA Wireless Systems", IJACT: International Journal of Advancements in Computing Technology, vol. 5, no. 9, **(2011)**, pp. 213-220.
[12] R. Soungalo, L. Renfa and Z. Fanzi, "Evaluating and Improving Wireless Local Area Networks Performance", IJACT: International Journal of Advancements in Computing Technology, vol. 3, no. 2, **(2011)**, pp. 156-164.
[13] L. Tong, G. Xu, B. Hassibi, and T. Kailath, "Blind channel estimation based on second-order statistics: a frequency-domain approach", IEEE Trans. Inform. Theory, vol. 41, **(1995)**, pp. 329-334.
[14] A. M. Rahmani, N. K. Thanigaivelan, T. N. Gia, J. Granados, B. Negash, P. Liljeberg and H. Tenhunen, "Smart e-health gateway: Bringing intelligence to internet-of-things based ubiquitous healthcare systems", In Consumer Communications and Networking Conference (CCNC), 2015 12th Annual IEEE, **(2015)**, pp. 826-834.
[15] Y. Li, Y. Zhang and P. Li, "An Efficient Trusted Chain Model for Real-time Embedded Systems", 2015 11th International Conference on Computational Intelligence and Security (CIS). IEEE, **(2015)**, pp. 428-432.
[16] T. Okamoto, "A digital multisignature scheme using bijective public-key cryptosystems", ACM Trans. Computer Systems, ACM Press, New York, vol. 6, no. 4, **(1988)**, pp. 432-441.
[17] S. M. Hart, "Interface for use with a video compression system and method using differencing and clustering: U.S. Patent 8,990,877", **(2015)**.
[18] A. Boldyreva, "Threshold signature, multisignature and blind signature schemes based on the gap-Diffie-Hellmangroup signature scheme", In Proceedings of PKC 2003, LNCS 2567, Springer, Berlin, **(2003)**, pp. 31-46.
[19] S. M. Hart, "Interface for use with a video compression system and method using differencing and clustering: U.S. Patent 8,990,877", **(2015)**.
[20] D. Boneh, C. Gentry, B. Lynn, and H. Shacham, "Aggregate and verifiably encrypted signatures from bilinear maps", In Proceedings of Euro-crypt 2003, LNCS 2656, Springer, Berlin, **(2003)**, pp. 416-432.
[21] A. Boldyreva, C. Gentry, A. O'Neill and D. H. Yum, "Ordered Multisignatures and Identity-BasedSequential Aggregate Signatures with Applications to Secure Routing", In Proceedings of the 14th ACM Conference on Computer and Communications Security, ACM Press, New York, **(2007)**, pp. 276-285.

