Implementation of an Investment Information System Based on Google Maps API

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Abstract*:* Obtaining more accurate information of investment chances and the most suitable places for each investment in a specific country are the most concerning things for investors, especially for foreign investors. In this paper, we constructed an information system for investment in Egypt using online map services such as Google Maps API. Based on J2EE platform, adopting technologies of Google Maps API, JavaScript, Liferay Content Management System, SQL Server 2014, and JSP the system was implemented. The system was tested over different platforms such as Microsoft Azure Cloud, VM on Cloud, and on a private remote server. Also, query time at each platform is measured.

Keywords: Investment Information System; Google Maps; Azure Cloud; VM; Remote Server; Liferay.

I. INTRODUCTION

Investment is defined as the current commitment of money or other resources in the expectation of reaping future benefits or sacrificing something of value now, expecting to benefit from that sacrifices later [1]. Examples of investing are: Bonds, most mutual funds, most ETFs, individual stocks, etc. Real Estate used for the production of goods and services, or as rental property. Buildings such as retail space, office space factories, etc. Investing is different from saving. Investing he best way to build wealth and increase your financial security over time, but it is at risk. Saving, on the other hand, is income that is not spent or put at risk. Example of saving is bank savings account, which earns relatively low rates of interest. The return on the savings may be outweighed by inflation, tax and account charges. Based on performance of the asset, investing may involve the possibility of profits and losses.

Investing is not gambling. Gambling is putting money at risk based on chance. Almost all gambling involves risk that exceeds the expected reward. Examples of gambling are all lotteries, currency trading of futures and options, commodity futures and options trading, and Casino games. A real investor does not simply throw his or her money at any random investment; he or she performs thorough analysis and commits capital only when there is a reasonable expectation of profit [2].

In this research, we concentrate on the available investment fields in Egypt such as agriculture, industry, transportation, health care, education, tourism, communication and information technology, and renewable energy fields.

We collected information about all these fields and constructed an information system that helps investors to take their investment decisions.

The Google Maps initiated in 2005 has big changed in online mapping service applications on the World Wide Web. Based on Asynchronous JavaScript and XML (AJAX), a new type of client/server interaction was presented in Google Maps to maintain a continuous connection between the client and the server for immediate downloading of additional map information. In addition, Google also provides programmers its comprehensive sources of code called the Application Programming Interface (API). The API consists of a grouping of data structures, object classes or functions that can be used by a programmer using JavaScript, PHP or other scripting language [7].

Cloud computing is an evolving style to deploy and maintain software and is being approved and used by the industry such as Microsoft, IBM, Google, and Amazon. Several prototype applications and platforms, such as the IBM "Blue Cloud "infrastructure, the Google App Engine, the Amazon Cloud, and the Elastic Computing Platform. Cloud Computing can demonstrate to be a future computing paradigm for Information Support Systems [3]. Cloud computing uses visualization as a core technology for sharing resources that contain infrastructures, software, applications, and business processes. The main characteristics of cloud computing are scalability and the ability of making available computational power and storage dynamically in a cost efficient and secure way over the web [4].

Another characteristic of cloud computing is its support of Service Level Agreements (SLA) that defines different service quality guarantees (for example hotline support, web service mean up time or a specific numbers of accessible CPUs) and contractual penalty clauses. Such contracts are of general importance for cost-performance ratio transparency in SOA governance, therefore such contracts are essential characteristics for potential future geospatial business models with defined value propositions.

These characteristics lead to the benefits efficiency, scalability and On-demand services.

In this research, we constructed the investment information system that uses the Google maps tools and Microsoft Azure cloud technology for hosting the application and measure the query processing on the cloud. The rest of this paper is organized as follows: in section II, we present the related work. In section III, we present the methodology used in this research (Google maps, Liferay, and Microsoft Azure). In section IV, we present the architecture of the investment system. In section V, we present the implementation of the system. Then, in section VI we present tests and results. Finally, in section VII we present conclusion and future work.

II. RELATED WORKS

There is a lot of relevant work to discuss and we will briefly mention some here. In [6] the authors developed a tourism information system using Google Maps API along with other technologies such as Web GIS, Ajax, JSON, and J2EE platforms such as Strurs2 framework. This system was developed to enable tourists to obtain more references for their travels.

In [7] the authors developed an online mapping application to display thousands of gardens on the Internet for the United States Department of Agriculture (USDA). Several technologies were employed to develop this application such as Google Maps API, Google Geocoderer, Microsoft SQL database, Microsoft aspx.NET, and Spry Framework for Ajax.

In [8] the authors developed a land use information system based on Google Maps API, XML, and AJAX.

In [9] the authors developed an expert system for tourists using rapid web development method which used the following technologies Google Maps API, XHTML, CSS, XML, JavaScript, AJAX, PHP scripting language, JQuery JavaScript library, SQL relational database language, Keyhole Markup Language (KML), and GeoRSS Geography Markup Language (GML).

III. METHODOLOGY

In this section, we present a detailed description of the key technologies used in developing this system. The key technologies used in this system are:

- Microsoft Azure Cloud
- Google Maps API
- Liferay Content Management System

A. *Microsoft Azure Cloud*

Windows Azure was founded by Microsoft as its cloud computing service platform in Microsoft Professional Developers Conference (PDC) 2008. Initial access in the Community Technical Preview phase from spring 2009. The availability of Commercial of Windows Azure has started since January 2010 [14]. Microsoft's Windows Azure platform contains three components and each Component provides a group of services to cloud users.

Windows Azure provides a Windows based environment used for running applications and storing data on servers; SQL Azure provides data services in the cloud based on SQL Server; and .NET Services provide distributed infrastructure services. Windows Azure platform can be used in two ways first by applications running in the cloud .second by applications running on local systems [15].

The Database tested on two different cloud services:
- Azure SQL Database: called in industry Platform as a Service (PaaS). Microsoft Azure SQL Database is built on own Microsoft hardware and software. The way of use Azure SQL Database by using built-in features and functionality through develop on the service and Azure SQL database easy to allow scale up or out for greater power.
- SQL Server in Azure Virtual Machine (VM):called in industry is an Infrastructure as a Service (IaaS) that is allows setup and running SQL Server after setup virtual machine including operating system in the cloud and the assign to (VM)the same hardware configuration that is configured in a remote server. Virtual machine also is built on own Microsoft hardware and software.

B. Google Maps API

Google Map is the core component of the investor information system. All searching results are displayed on it. The investor can interact with it to zoom in, zoom out, panning to a specific location, and displaying information about any investment on a pop up window on a marker [9].

Google Maps is a Google provided web-based mapping service developed to provide a slick, highly responsive visual interface built using AJAX technologies. Google Maps API is a free service that was created to allow developers to integrate Google Maps into their web applications [9].

Google Maps API is based on a simple suite of components within a JavaScript container directly within a XHTML page. These components were loaded from Google every time we opened a Google Maps web page. All of Google Maps functionalities are based on this embedded JavaScript objects built in a web page. These objects provide the interface to the Google Maps service and generate the map on users screen by loading the necessary image components and tiling them onto the display. The API interface was hiding some powerful classes, objects, and interfaces that enabled us to manipulate the Google Map. Combining this interface along with the data that we want to display, it is possible to support interactive elements on the web page without reloading the page or the portions of the map. This possibility is thanks to the AJAX technology involved in Google Maps API [9].

The Google Maps API is suite of JavaScript classes that we use to build web applications. Understanding of the API relies on knowing the terminology used to define sections of the Google Maps API and interface [9].

Google Maps applications usually start with a simple map. To this Map we add a number of different elements designed to provide the application functionality. We used a number of these elements in our system, such as:

Overlays: overlays represent Point of Interest (POI) on a map or lines denoting routes, areas, or other information about the location being displayed. Examples of overlays are the markers used to indicate the place and type of investment on the map.

Events: events are triggered by performing some action on a control on the map, such as the event of clicking a maker icon to display Information Window contains information about the investment category in that place.

Controls: controls are some basic interface controls that enable user to zoom in, zoom out, moving the map effectively, and the ability to change between map types.

We benefit from the advantage of Google Maps support for standard WEB technologies in our system and used the following technologies:

XHTML: Google Maps work embedded in any standard HTML page, but Google recommends that we create pages compatible with the XHTML standard because this will ensure not only that the code is compatible with the standard of most browsers, but also the reliable rendering of our web page.

JavaScript: Google Maps API is based on the JavaScript language. JavaScript was built into the most of web browsers and provided a rich suite of functionality for developing dynamic web elements [9].

AJAX: Asynchronous JavaScript and XML (AJAX) is the art of exchanging data with a server, and updating parts of a web page - without reloading the whole page. It is not a new programming language, but a new way to use existing standards [9].

C. Liferay Content Management System
Liferay Portal is an open source project based on Java Programming Language. It was developed by Liferay Company, a united states' company. It includes a complete stack of J2EE applications.

It comes in two versions: Community Edition (CE) and the Enterprise Edition (EE). It uses Hibernate, Struts, Spring and other open source Java frameworks. It follows standards such as JSR-168, JSR-127, JSR-170, JSR-286 (Portlet 2.0), and JSR-314 (JSF 2.0). It also uses the latest Java and Web 2.0 technology to develop web applications [16].Liferay Portal using Service-Oriented Architecture (SOA) design principles, and provides tools and frameworks to extend SOA to other enterprise applications. Under the Liferay framework, developers can use the open API (REST, SOAP, RMI, XML-RPC, XML, etc…) in addition to custom tunnel class to operate the portal [16].

Liferay Portal using the J2EE hierarchy principle, including the presentation layer, business logic layer, data persistence layer. Presentation layer in Liferay uses standard Portlet component and Liferay custom UI tag library. Liferay Portal business layer and data services layer using the Spring framework, which provides a service interface to the upper layer and also manages the Liferay's affairs.

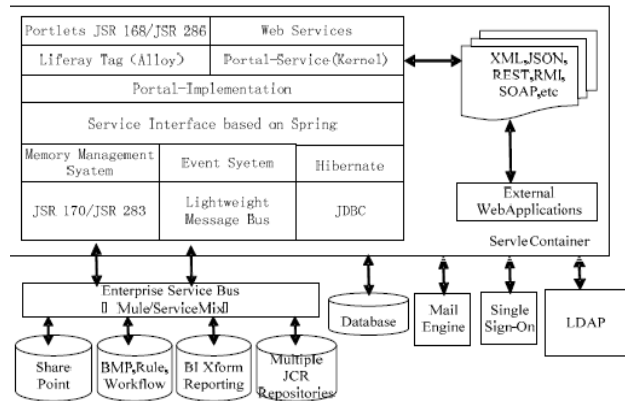Figure 1 shows the Liferay Portal architecture [16].

Figure 1: Liferay Portal architecture [16].

As shown in figure 1, to facilitate enterprise application integration, Liferay extends web applications by using the Web Services technology in Liferay remote functions. Liferay Portal supports REST style services and JSON lightweight Web services, so it is easy to maintain the code. It also supports Ajax-based user interface to improve the user experience [16].

Enterprise Service Bus (ESB) is a product of traditional middleware technologies such as XML and Web services. It eliminates the technical differences between applications. It also enables different application servers coordinate operation; realize communication and integration between different servers. Using ESB can quickly add applications and services to the enterprise infrastructure [16].

Liferay Portal's persistence layer using Hibernate framework to process business data. Using Hibernate to achieve persistence has the benefits of efficient and flexibility [16].

The Liferay portal has three main parts: Portlet, Portal Server, and Portlet Container. The Liferay composition structure [16] is shown in figure 2.
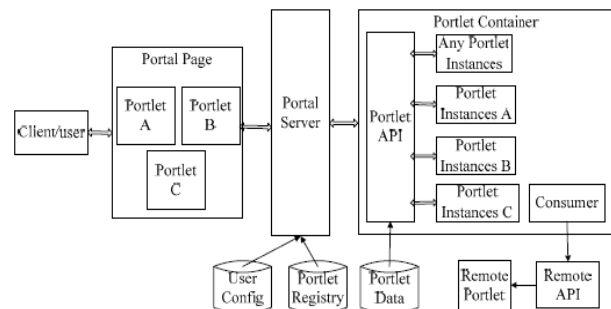

Figure 2: Liferay portal main parts [16].

(1)Liferay Portlet: it is a java based web component which is managed by the Portlet Container. Its role is to handle the user request and creates all kinds of dynamic request information. It has a complete life cycle like any web

application. Its life cycle is controlled by Portlet Container [17].

(2) Liferay Portlet Container: it is similar to the web container that manages servelet. Its role is to provide Liferay's Portlet execution environment. It includes many Portlets and manages their life cycle, saves customized information of them. When it receives a request from the Portal, it will transmit it to the Portlet in the container to execute. The Portlet container itself will not combine the information contents produced by Portlet, the combination work is handled by the Portal [17].

(3) Liferay Portal Server: it is a Portlet Container that supports for the general or particular Portlet web server. It provides personalized settings, single sign-on, content polymerization, information release; permission management functions, supports various information sources of data, and combines these data information into your web pages to provide personalized contents [17].

IV. ARCHITECTURE OF THE INVESTMENT SYSTEM

The investment information system architecture is a three-layer architecture which includes presentation layer, business logic layer, and data layer. The advantage of the three-level architecture is the separation between system layers, which increase performance, flexibility, maintainability, reusability, and scalability. The architecture of the system is shown in figure 3.
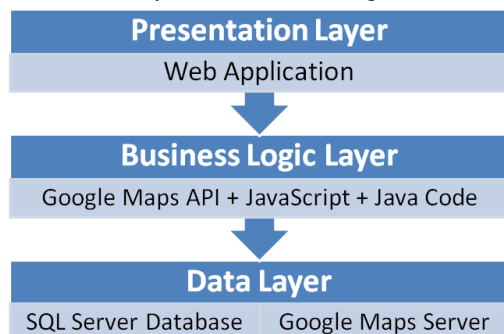

Figure 3: The architecture of the investment system.

The data layer includes two main servers, a map server and a data server. The map server is the Google Maps server which responsible for the storing of Google Maps data. The data server is a SQL server database used to store the information of various investments in various places in Egypt.

The business logic layer is responsible for displaying results of queries, handling users' requests through Google Maps API and JavaScript functions, and manipulating with data stored in the SQL server database.

The presentation layer is a web mapping application containing a Google map and is responsible for displaying the search results on the Google map as a group of markers with different icons and each icon represents a category of investment. When the investor clicks a marker icon, a pop up window is displayed. This window contains information about the investment in this place.

The investment information system deals with two types of data: Google Maps data and user data. Google server is responsible for providing Google Maps data through network. The type and the content of Google Maps' data are rich and varied, and updated constantly with the expansion of Google business. User data includes investment information data, which is stored in a SQL server database hosted on various locations such as:

Microsoft Azure, VM on a cloud, or on a remote server to test and compare the search query time on these environments.

V. IMPLEMENTATION

The investment information system was implemented using the following technologies:

- Java Programming Language
- Liferay Content Management System
- Google Map APIs
- JavaScript
- AJAX
- HTML
- Microsoft SQL Server 2014
- Microsoft Azure Cloud

The main interface of the system (Presentation Layer) and the database functionalities are implemented using Java Programming Language and Liferay Content Management System. The Google Map is displayed inside a web application. The Google Map APIs, JavaScript, HTML, and AJAX are used to render the map inside web application. Microsoft SQL Server 2014 was used to create the database of the system and it was hosted on the Microsoft Azure and on Virtual Machine under Cloud. The main interface of the application is shown in figure 4.
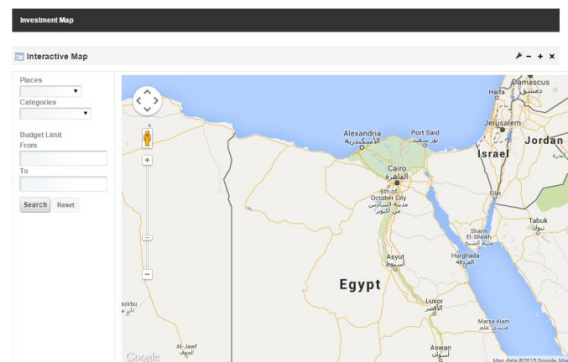

Figure 4: The main interface of the investment system

The investor can search for all available investment in Egypt or he / she can select a specific place in Egypt form the governorates drop down list or by clicking on any place on Egypt map. Also, investor can search for a specific investment category in a specific place. The results of the search will be displayed on the map as a group of markers with different icons, each icon represents a category of investment, and the investor can view summary information about this investment by clicking on its icon to show a pop up window contains the summary information.

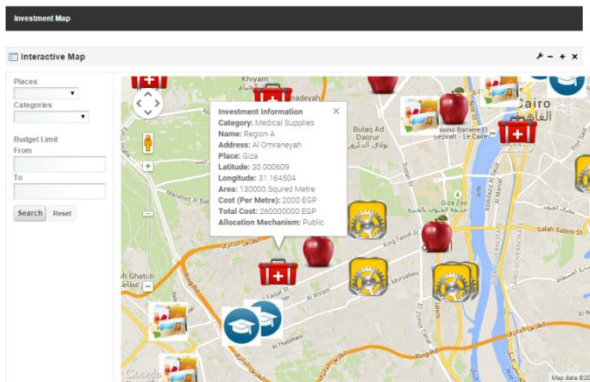Figure 5 shows part of the result for searching all investment projects in Egypt.

Figure 5: Part of investment projects in Egypt.

We used different icons for projects types, figure 5 shows different icons on the map. Each icon represents an investment category. The red apple icon represents agriculture investment. The yellow gear icon represents an industrial investment. The first aid bag icon represents a medical investment. The blue success hat icon represents an educational investment, and this icon represents tourism investment.

Figure 6 shows the result for searching for a particular investment category in a specific place in Egypt.
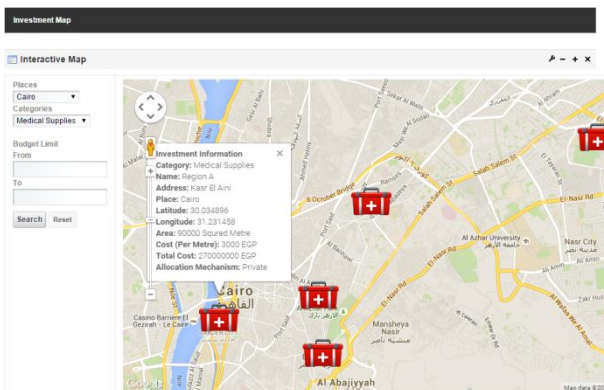

Figure 6: Medical Supplies Investment in Cairo governorate

If the investor clicks on an icon on the map, for example medical project, then short summary about the project is displayed with the following information: Category, Name, Address, Place, Latitude, Longitude, Area, Cost per metre, Total Cost, and Allocation Mechanism (Public, Private), project page link etc.

Also, investor can search about projects with limited budget. Administrator can insert or update or delete investment projects data.

VI. TESTS AND RESULTS

For testing and comparing the performance of the system, the search query time was tested by sending the same query to the database engine hosted on three different environments sequentially: Microsoft Azure, Virtual Machine on private cloud, and private remote server. The search query was sent from the same machine that run the application and with the same internet connection speed.

The system requires a connection to the database server on each environment to load the data into the map.

For example suppose that the investor wants to search for the medical investment in Cairo governorate. He will select "Cairo" from the Places drop down list and "Medical Supplies" from the Categories drop down list and then click "Search" button to send a search query to the database. The search query is as following:

"SELECT * from Information WHERE palceName = 'Cairo' AND categoryName = Medical Supplies".

This query is sent to a database hosted on Microsoft Azure and executed and the results are displayed on the map as a group of markers represents the regions that match the query criteria. The investor can click to any marker to get information about the investment in this place.

The result of executing this query on the database hosted on Microsoft Azure is shown in figure 7.
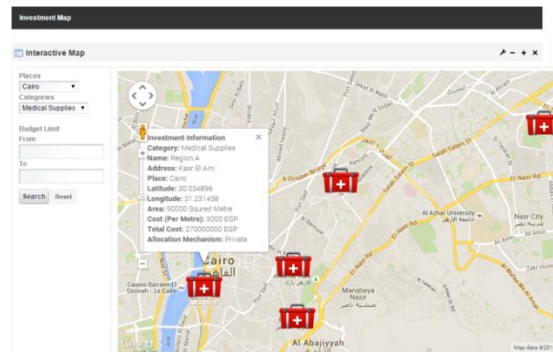

Figure 7: Search query sent to Microsoft Azure

Figure. 8 shows the results of executing the previous search query on a database hosted on a private remote server.
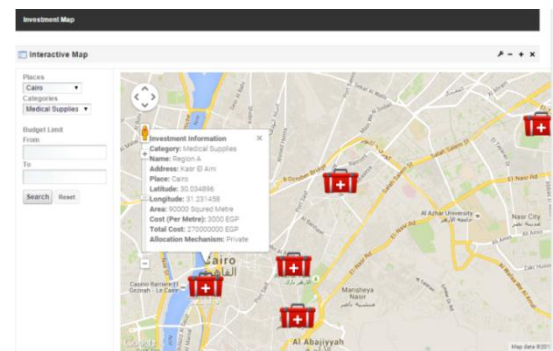

Figure 8: Search query sent to Remote Server

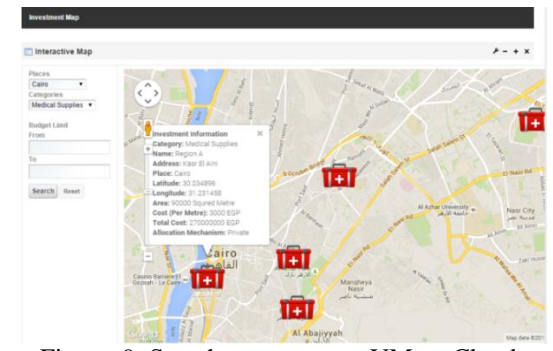Figure. 9 shows Results of executing the same query on a database hosted on a VM on a cloud.

Fig.ure 9: Search query sent to VM on Cloud.

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For comparing the performance of the system, the search query time on each server is measured and the results are shown in figure 10.
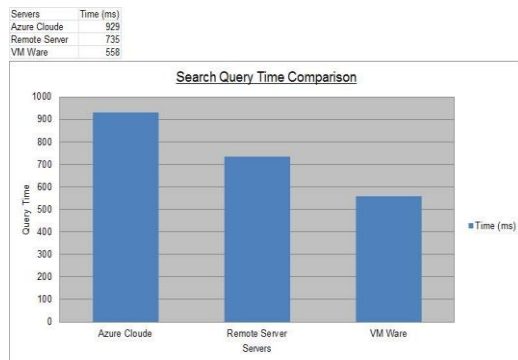

Figure 10: Search query time comparison results

Figure 10 shows that the implementation of the query on a virtual machine on a private cloud is the best, which took the shortest time, then the implementation on a private remote sever and lastly the implementation on the Windows azure which took the longest time.

VII. CONCLUSION AND FUTURE WORK

In this paper, an investment information system based on Google Maps API was implemented to help investors to take their investment decisions. Also, query time is measured in three different environments: SQL server database hosted on Azure Cloud, SQL server database hosted on a VM on cloud, and on SQL server database hosted on a remote site. In our future reach, we plan to implement the system as a decision support system that can analyze different investment projects and compare among them and display the best investment project for the investor. Also, to improve the performance of query processing on the cloud environment, we plan to implement the queries by using map-reduce and parallel processing concepts.

REFERENCES

[1]   ZviBodie, Alex Kane, and Alan J. Marcus, "Essentials of Investments", McGraw−Hill education, 2003.
[2]   Ken Faulkenberry, " Saving, Investing, and Gambling: The Importance of Differentiation and Compartmentalization", http://www.arborinvestmentplanner.com
[3]   Bhat, Muzafar Ahmad, et al. "Cloud computing: a solution to Information Support Systems (ISS)." International Journal of Computer Applications (0975–8887) Volume 11 (2010).
[4]   Schäffer, Bastian, Bastian Baranski, and Theodor Foerster. "Towards spatial data infrastructures in the clouds."Geospatial Thinking. Springer Berlin Heidelberg, 2010. 399-418.
[5]   Bhat, Muzafar Ahmad, RazeefMohd Shah, and Bashir Ahmad. "Cloud Computing: A solution to Geographical Information Systems(GIS)." International Journal on Computer Science and Engineering 3.2 (2011): 594-600.
[6]   Wu, Yimeng, Zhixue Liang, and Liming Liu. "Design and implementation of tourism information system based on Google Maps API." Geoinformatics (GEOINFORMATICS), 2013 21st International Conference on. IEEE, 2013.
[7]   Shunfu Hu, Ting Dai. "Online Map Application Development Using Google Maps API, SQL Database, and ASP.NET." International Journal of Information and Communication Technology Research, Volume 3 No. 3, March 2013.
[8]   Hao Zhang; Manchun Li; Zhenjie Chen; ZhiliangBao; Qiuhao Huang; Dong Cai, "Land use information release system based on Google Maps API and XML," in Geoinformatics, 2010 18th International Conference on , vol., no., pp.1-4, 18-20 June 2010.
[9]   Pejić, Aleksandar, SzilveszterPletl, and BojanPejić. "An expert system for tourists using Google Maps API." Intelligent Systems and Informatics, 2009.SISY'09.7th International Symposium on.IEEE, 2009.
[10] Zhang, Liang-Jie, and Qun Zhou. "CCOA: Cloud computing open architecture." Web Services, 2009.ICWS 2009.IEEE International Conference on.Ieee, 2009.
[11] Boutaba, Raouf, and Nelson LS da Fonseca. "Cloud Architectures, Networks, Services, and Management." Cloud Services, Networking, and Management (2015): 1-22.
[12] You-Qun Shi; Jian-Wei Zhou; Peng Wang; Ran Tao, "Research and Implementation of the Collaborative Learning Platform Based on Liferay," in Enterprise Systems Conference (ES), 2014 , vol., no., pp.331-335, 2-3 Aug. 2014.
[13] Yin-Li Zhang; Wei Pan, "Legal risk service portal system solution based on Liferay," in Apperceiving Computing and Intelligence Analysis (ICACIA), 2010 International Conference on , vol., no., pp.112-115, 17-19 Dec. 2010.
[14] Li, Jie, et al. "escience in the cloud: A modis satellite datareprojection and reduction pipeline in the windows azure platform." Parallel & Distributed Processing (IPDPS), 2010 IEEE International Symposium on. IEEE, 2010.
[15] Zhang, Qi, Lu Cheng, and RaoufBoutaba. "Cloud computing: state-of-the-art and research challenges." Journal of internet services and applications 1.1 (2010): 7-18.
[16] Shi, You-Qun, et al. "Research and Implementation of the Collaborative Learning Platform Based on Liferay." *Enterprise Systems Conference (ES), 2014*. IEEE, 2014.
[17] Zhang, Yin-li, and Wei Pan. "Legal risk service portal system solution based on Liferay."Apperceiving Computing and Intelligence Analysis (ICACIA), 2010 International Conference on. IEEE, 2010.

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