

A Cloud Computing Based Sales Forecasting System for Small and Medium Scale Textile Industries

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Abstract— As the textile market becomes progressively more competitive and market driven. Sales data analysis through Sales Forecasting techniques provides insight into product preferences and changing preferences over the period of time. Traditional web based application does not provide good scalability, availability, on-demand service and as well as cost effective solution to SME. We propose a cloud computing based sales forecasting (CCSF) system, which uses time series based three year moving average method for sales forecasting. CCSF system was developed using php, MySql and deployed on azure cloud. CCSF system can provide a good scalability, reliability, quick response time under high user load and as well as low cost sales forecasting solution to SME.

Index Terms—Cloud computing, sales forecasting, time series, textile industries.

I. INTRODUCTION OF SALES FORECASTING AND CLOUD COMPUTING

A Sales forecast is process of projecting sales revenue for a specific period in the future. An accurate sales forecast is essential to understand, manage sales activities, and for financial planning purpose such as:

- a. Understanding and managing the company's cash flow.
- b. Planning procurement, production and logistics capacity.
- c. Developing the fundamental of revenue projection [1].

Forecasting activity should help managers to make good choices in the procedure of preparing the business technique. The objective of preparing procedure is to manage company resources in a manner to achieve desired sales. There are different periods when market researchers need to predict forecasted results:

- a. Short term forecasts – these are usually for periods of up to three months ahead and are used for situations such as production planning.
- b. Medium term forecasts – these have direct impact for planners to plan strategic decisions such as business budgeting which is the starting point of sales forecast. So, if the sales forecast is not correct then the whole budget will become incorrect.

c. Long term forecasts –these are mainly for forecasting horizon of three years and more. It depends upon the type of industry or sector being considered. Such forecasts are required by finance consultants for resource requirements in near future and mainly concern the boards of directors [2].

The sales forecasting methods can be categorized as follows:

- a. The qualitative methods and
- b. The quantitative methods.

A. Time Series Forecasting

A time series forecasting is a collection of data observed over a period of time intervals such as week, month, quarter, or year. Historic data are analyzed and used by management to make current decisions and plans based on long-term forecasting. It is usually assumes that past patterns will continue into the future. Long-term forecasting can be extended up to more than 1 year into 5, 10, 15, and 20 year projections. Long-term forecasting gives sufficient time for the manufacturing, procurement, finance, sales and other departments of an industry to develop strategies for new plants, development of new products, financing, and new techniques of assembling.

II. INTRODUCTION TO CLOUD COMPUTING

Cloud computing is the next generation in computing technology. It is the evolution of on-demand information technology services and products. Cloud computing is a style of computing which provide IT-related services “as a service”, and it allows users to access these services from the internet (i.e., from the cloud) without any knowledge of, or expertise with, over the technology infrastructure that supports them. Email was the first service on the “cloud”. There are various cloud platforms available as the computing industry moves toward providing platform as a service and software as a service for consumers and industries to access on demand services. Cloud computing types are defined in terms of public, private, hybrid and community cloud which are as follows:

A. Public Cloud

According to Gartner's definition, the public cloud computing is a style of computing in which scalable and elastic IT services are provided as a service to external

customer that uses Internet technologies, i.e. public cloud computing uses cloud computing technologies to help users which are external to the service provider's organization.

B. Private cloud

This is also known as enterprise cloud or an internal cloud, which provides cloud functionality "as a service" and is implemented over a company intranet or company hosted datacenter. This is a private product for a company or organization providing greater security and highly available or fault tolerant mechanism which is not possible in a public cloud.

C. Hybrid Cloud

This approach combines the advantages of both private and public cloud. In hybrid cloud rules are customized and govern policies areas such as the underlying infrastructure and security. As per the requirement activities and tasks are assigned to external or internal clouds.

D. Community cloud

Community cloud is shared by multiple organizations, and generally externally hosted, but can be internally hosted by one of the organization.

Cloud computing model is defined according to services provided to the user and these services are defined as follows:

E. SaaS

Software as a service (SaaS) provides consumer to use on-demand software which is offered by the service provider using a web browser over the Internet and it is a thin client device. With SaaS the consumer has no control or management of the infrastructure such as the network, operating systems, storage or servers and no control over the application's capabilities. SaaS is a fast and efficient delivery model for business applications such as enterprise resource planning, HR and payroll, customer relationship management [3].

F. PaaS

Platform as a Service provides consumers to have applications deployment facility without the burden and cost, of managing and buying the hardware and software. These are either consumer created or can be acquired web applications or services which are purely accessible from the Internet. Programming languages and tools are supported by the service provider and these web applications enable users to have control on the deployed applications and in some situations the application-hosting environment but without the burden and complexity of the underlying infrastructure i.e. the servers, storage or operating systems. Offering a fast time to market and services over the web which can be provisioned as an integrated solution, PaaS helps immediate

business requirements for e.g. application design, development and testing at very normal cost [4].

G. IaaS

Infrastructure as a Service provides the facility of the underlying infrastructure to the consumer. The Service Provider owns the equipment as well as responsible for its running and maintenance, while the consumer will be charged according to 'pay as you use' basis. IaaS sometimes provides a horizontally integrated service which consist storage and servers and also the connectivity domains. For example the user deploy, runs applications and operating systems, the IaaS provider provides the backup and archiving (Storage), replication and the powerful computing requirements (Server), the load balancing and firewalls (Connectivity domains) facilities [5].

III. PROPOSED CCSFS MODEL

Proposed CCSFS model provides sales forecasting for small and medium scale textile industries, with good scalability, availability, on-demand access from anywhere, anytime and also a cost effective solution. The service of CCSFS is accessible by end user from anywhere and by any smart phone or personal computer with internet connection. CCSFS model can be used by other industries with a minor modification in algorithm. There is no security and maintenance cost for the SME's users.

In the generalized architecture of CCSFS model, each layer gives plug and play architecture with services from each other layers. Every layer provides horizontal scalability as required. Functionality of each component is as follows:

A. Commodity hardware platform

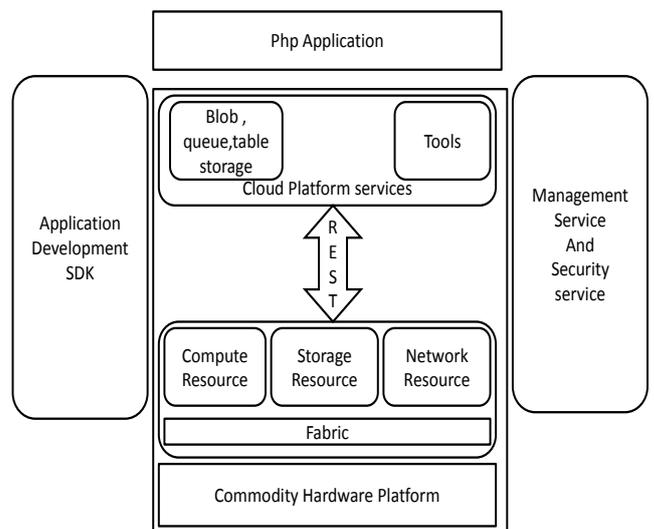


Fig. 1: Generalized Architecture of CCSFS Model

The commodity hardware platform provides the virtual, physical and software assets. These assets are physical machines, operating systems, network systems, power management, virtualizations software and storage systems. For above layers, bare metal and other resources are abstracted as virtual resources.

B. Cloud infrastructure services

This layer is also known as Infrastructure as a Service (IaaS). It manages resources and abstracts the hosting platform as a virtual resource according to the availability and scalability requirements. This layer also provides three types of abstract resources: storage, compute and network, and provide a set of APIs to manage and access resource abstractions. Thus consumer gain access to the physical resources without knowing the structure of the underlying software and hardware and can manage these systems efficiently through configuration.

C. Storage

The storage service enables storing resources in the cloud in a secure and scalable way. Those resources may be named files, like documents, images or video, together with relevant metadata information, or may be structured or semi-structured information. There are three forms of storage provided as data services available through an HTTP API:

- i. Binary Large Objects (BLOB):* It's the simplest way of storing named files in Azure, for storing high volumes of data.
- ii. Tables:* Ideal for storing high volumes of structured data, being able to use a query language for querying them. This is not, related to the relational model, as the table storage service provides no SQL support, nor foreign key constraints or other relational capabilities. Data is stored in the form of entities with properties, corresponding to massively scalable tables which are replicated for preventing data loss, and partitioned across several machines to improve query performance.

iii. Message Queues: Used for asynchronous communication between two roles.

D. Compute

Windows Azure Compute provides developers a platform for running, storing, and managing applications. These applications may be developed with help of web role, worker role and vm role.

E. Cloud platform services

Services of this layer provide ease to manage and develop cloud computing software. It also provides interfaces to integrate on-premise software with hosted platform services.

Platform services give a set of services to help and manage with such integration. For example, Microsoft .NET service bus helps with access and discovery and Microsoft .NET access control service helps rule and role based claims mapping and transformation in the azure services platform. Availability of platform services may distinguish one cloud provider from another. This service of this layer comes under Platform as a Service.

F. Cloud applications

It consist those applications which are built for cloud computing. These applications depict web services and web interfaces for end users, which enable multitenant hosting models. Some functions comprise linking distinct systems and leveraging storage infrastructure to store documents. These facilities come under the Software as a Service.

G. Security services

These services ensure identity federation, claims transformation and token provisioning. These are built on the following open standards: web service security, web service federation, web service trust, OpenID and SAML protocols, for higher interoperability.

H. Management services

These services come across all the above layers which are described. For automated availability and scalability administration the hosting platform leverages agents and management interfaces. Even though the cloud is managed and hosted in a data centres, users may require services that allow them to easily control application and post deployment configurations, connect their enterprise management systems, and get analytics about service usage.

I. Tools

Tools help to build, test, and deploy the applications into the cloud. These tools are sql azure account portal, sql server management studio and extensions of existing tools such as visual studio tools or hosted tools from a particular cloud provider [6].

IV. WEB ROLE AND WORKING ROLE

A. Web Roles

It presents website contents to the end-user. It fully supports IIS which enable several sites to run in a one web role. Tasks that require computational resources should run in a worker role.

B. Worker Roles

Worker roles are aimed at executing tasks that required higher computational resources. With help of message queues communication with other roles may be accomplished.

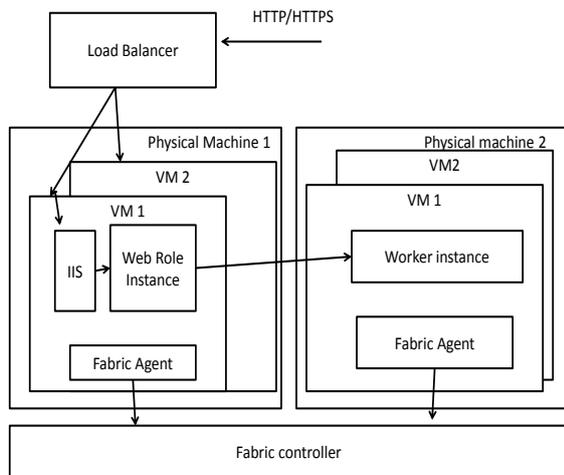


Fig. 2: Working of Web Role and Worker Role

C. VM Roles

Each VM, running web or worker roles, contains a fabric agent that allows the application to interact with the fabric controller. There is a choice of four VM sizes which is offered to users: one core, two cores, four cores, and eight cores to scale applications performance (number of running instances defined by users in the configuration file). The fabric controller runs VMs, assigns them to cores and runs the number of instances of application. It is able to identify an instance failure and start a new one [7].

V. WORKING OF PROPOSED CCSFS MODEL

Basic working of proposed CCSFS architecture can be described as given below:

Step1: User sends http request to CCSFS through web browser.

Step2: The http request is handled by a load balancer, which transfer the incoming request according to the round robin basis to Web role.

Step3. If the requested web pages require no other computing resources then web role directly fetch the stored pages from azure storage and present it to the user.

Step4. If the incoming request require some computing resources then web role put this request in queue, from there worker role (which is free) fetch the request and made available the resources and perform the appropriate action.

Step5: after finishing the operation, worker role send it to the web role and presented it to the user.

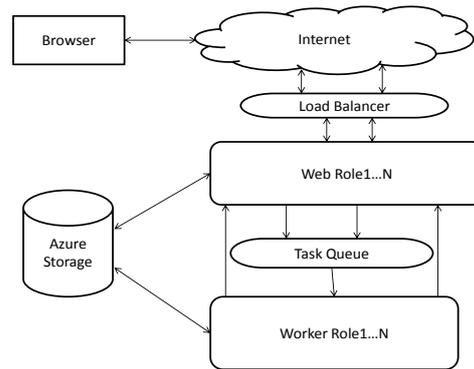


Fig. 3: Working Architecture of CCSFS Model

VI. DEPLOYMENT OF CCSFS

The proposed CCSFS model was developed using php, mysql and deployed on Microsoft windows azure cloud and simple sales forecasting web application was deployed on loltechnologies's web server also. Their corresponding URL's are "timeseries.azurewebsite.net" and "http://loltechnologies.com/timeseries/login.php" respectively.

VII. TESTING OF SALES FORECASTING APPLICATION ON AZURE AND ON WEB SERVER

The LoadwebUI is a load testing tool which is designed to test load, functional behaviour and performance of an application. It is used to test the sales forecasting applications on azure cloud and traditional web server. The experiment was conducted on the machine having following configurations: intel COREi3- 2.30GHz CPU, 4.00GB RAM, 100Mbps network card running over a 10/100 fast Ethernet Switch. The OS was used Microsoft Windows 7 Ultimate. It was found that the proposed CCSFS model gives latency .89sec, 2.34sec, 1.70sec, 0.83sec and web based system gives .77sec, 3.77sec, 3.36sec, 3.99 sec. for the virtual user 1, 20, 50, and 100 respectively. Also the page load time was about 1.18sec, 2.845sec, 2.13sec, 1.13 sec, and for that it was .77sec, 3.77 sec, 3.36sec, 3.99 sec for the user load 1, 20, 50 and 100 respectively.

VIII. CONCLUSION AND FUTURE WORK

It can be concluded that the proposed CCSFS model works even better in high user load conditions and can handle more requests simultaneously with lesser response time, whereas the web server has taken more response time and having high latency.

The proposed CCSFS model can be extended with other advanced forecasting techniques like fuzzy and neural

network. The proposed CCSFS can be deployed on open source cloud computing platform to decrease the cost factor.

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