

Novel Intelligent Electronic Booking Framework for E-Business with Distributed Computing and Data Mining

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Abstract

Web science, a general discipline of learning is presently at high demand of expertise with ideas to develop software-based WebApps and MobileApps to facilitate user or customer demand e.g. shopping etc. electronically with the access at their smartphones benefitting the business enterprise as well. A worldwide-computerized reservation network is used as a single point of access for reserving airline seats, hotel rooms, rental cars, and other travel related items directly or via web-based travel agents or via online reservation sites with the advent of social-web, e-commerce, e-business, from anywhere-on-earth (AoE). This results in the accumulation of large and diverse distributed databases known as big data. This paper describes a novel intelligent web-based electronic booking framework for e-business with distributed computing and data mining support with the detail of e-business system flow for e-Booking application architecture design using the approaches for distributed computing and data mining tools support. Further, the importance of business intelligence and data analytics with issues and challenges are also discussed.

Keywords:

big data, business analytics, data mining, data science, e-Booking, e-Commerce, web science;

Acronyms Used:

24/7	24 hours a day, 7 days a week (Any time, Every day)
AI	Artificial Intelligence
AoE	Anywhere-on-Earth
BI	Business Intelligence
DBMS	Data Base Management System (Software)
DDBMS	Distributed Database Management System
E-Booking	Electronic Booking
E-Business	Electronic Business
E-Commerce	Electronic Commerce
IBE	Internet-based e-Booking Engine
IoT	Internet of Things
ML	Machine Learning
MobileApp	Mobile Application Software
OOHMD	Object Oriented Hyper Media Design
PDA	Personal Digital Assistant
ROI	Return on Investment
UI	User Interface
WebApp	Web Application Software
WWW / www	World Wide Web

1. Introduction

The electronic business, well defined as e-business has engaged every person's life who use a mobile phone or have access to a computer. For everyday routine i.e. 24/7, from morning till dusk, listening and attending calls, sending and receiving WhatsApp messages, voice and video call sharing; booking taxi or ride, searching for despatch or courier service; or buying or ordering food from superstore online, or booking or reserving hotel room etc. The drastic revolution in the field of computing and communication technology have strengthened a large number of users and business ventures to get engaged via www – the World Wide Web also known as the internet. The major business firms, therefore, invested a huge budget to acquire the market by adopting this technology. This triggered the software export business all around the world [1] [2]. A study of technology and the methods to access the www and to place contents for use of concern entities is now highly essential learning objective in the field of Computer Science [3] [4] [5]. The development of Smart Computers, Smart Phones, Smart Digital Devices, Personal Digital Assistants (PDAs) has further enhanced the use of internet and www. The people of all walk of life e.g. engineers, doctors, lawyers, teachers, businessman, designers, manufacturers etc. with their age-slabs very frequently access the www through their smart digital gadgets to invoke the web application (WebApp or MobileApp) [6] [7].

Learning computer science especially “Web Science” and implementing new technologies for business administration are at high demand. A general discipline of learning which is highly demanding nowadays is “Web Science”. This discipline fulfils the requirement of developing WebApps, and MobileApps as software browsing tools to surf www and internet. The core technologies of Computer Science, i.e. Artificial Intelligence (AI), Distributed Computing, Network Structures, Machine Learning (ML), and Business Intelligence (BI) are handy to evolve social web. Web Science is an evolving interdisciplinary field study to explore and learn global socio-technical establishments of systems and structures e.g.



Fig.1. Socio-technical infrastructure on Social Web with Internet of Things (IoT) [7].

World Wide Web [1] [8]. “Business Intelligence (BI)” the word first coined in 1989, provides thoughtful decision making power to data scientists, office managers, corporate executives, and related customers to take genuine decision on business sales and purchase with having technology-based tools to instantly analyse data and predicting early results [9] [10] [11] [12]. BI utilizes a numerous web-based analytical tools, applications, and scientific methods of distributed relational databases (DDBMS) with analytical processing to accumulate and collect customer data from server side as well as client-side sources, applying filter to refine, applying queries to extract useful means, and generate reports and visual graphs which become handy for an organization to take rapid decisions [6] [12]. With the setup of distributed databases infrastructure, big data establishment become visible over the social web, commonly known as the Internet of Things (IoT) which is utilized by any user from Anywhere-on-Earth (AoE). Fig.1 describes the concept of web science and social web where people are connected via digital devices for virtual social interactions [7] [12]. “Big Data” is a huge collection of data very large in size and volume usually Exabyte; stored in data-farms which is a quite different method as compared to the traditional data warehouse; in a mixture of the structured, unstructured, and semi-structured form [13]. The past few decades have shown that the large business ventures scattered over numerous remote geographical zones have practiced to accumulate record history of their customer regarding sales, from different social ventures and e-Commerce and e-Business websites in various required formats where data scientists strive hard to explore and correlate these data-sets to realize and release valuable prediction for timely decision making for the prospects of business with mitigating risks [7] [14] [15] [16].

Today, in general, the major number of corporations are facing highly challenging and competitive atmosphere with having continual pressure for uplifting the revenue by recognizing possibilities for operative efficiencies like the use of web sphere technologies to increase profitability along with securing business risks towards the minimum. The large enterprises have apprehended the significance of analysing the masses of historical data which they have collected with the vision since past many years to use this data with the analytical processor to produce business parameter values with their margins of criticality. This vision has forced the organizations to set up an infrastructure for data retention and maintenance, making this an integral part to draw important business decisions to use the web science and business intelligence strategies for improvement in business flow. In this lieu, the large multinational companies have spent the budget to acquire data science expertise from academia and industry [17].

In this paper, we have introduced a novel and intelligent web-based electronic Booking framework for e-Business with distributed computing and data mining support. With the introduction in Section-I, Section-II discusses the e-business system flow for e-Booking Application. Section-III explained the internet based e-Booking (IBE) architecture design. Section-IV described the design model for WebApps and MobileApps for IBE. Section-V discussed the approaches for distributed computing and data mining support. Section-VI explained the importance of business intelligence and data analytics. The paper is concluded in Section-VII.

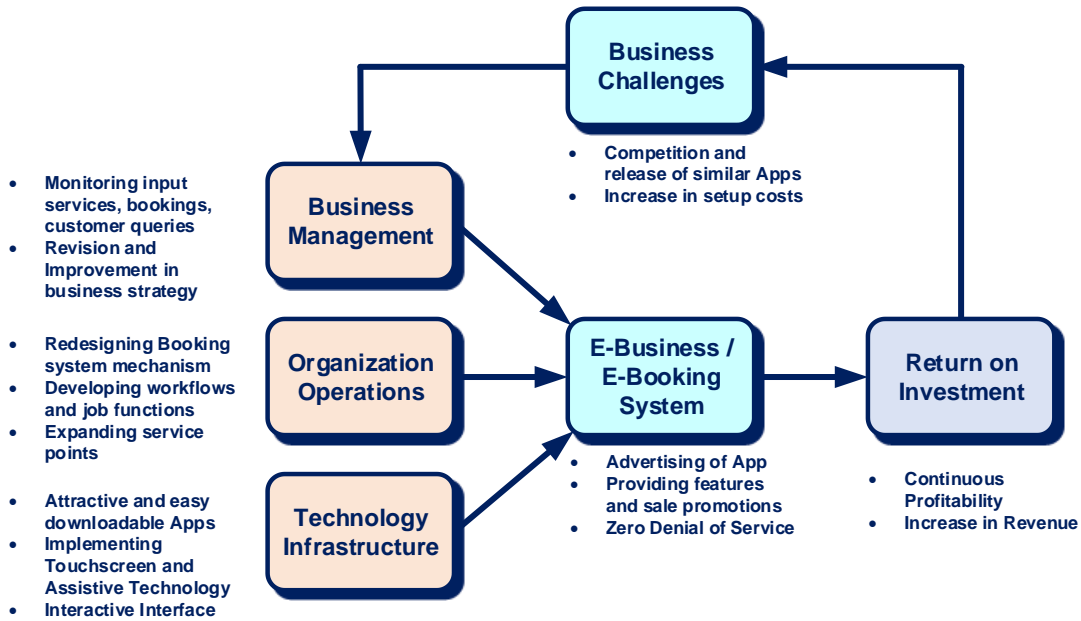


Fig. 2. E-Business/E-Booking System business flow with input, process, output and feedback, showing functions and features.

2. Discussion

2.1 E-Business System Flow for E-Booking App

The internet-based e-Booking system is a web-based software application that can run as MobileApp and WebApp, which covers business system intelligently. The user requires fast easy and hurdle-free access to the e-ticketing for which we have redefined the e-booking business system as described in Fig.2 adapted from [18].

The e-Business based e-Booking system follows all the norms of “System” design. It takes responses from three functions as input namely (1) Business Management, (2) Organization Operations, and (3) Technology Infrastructure, to operate business smoothly and efficiently. The system provides an output as (4) Service as well as ROI (Return on Investment). Feedback to check deficiency is also incorporated as (5) Business Challenge, which respond to the business management with feedback and criticism, which is rectified or improved and become again input to the E-Business System. The detailed function of each component of this system is described below.

2.1.1 Business Management

Business has various functions to run an enterprise smoothly. Here the core function is monitoring the input to process block i.e. e-Booking system. It monitors types and variants of booking, customer queries, services responses, revising criticism to provide improved input as a revision of policy function.

2.1.2 Organization Operations

This block work to redesign the booking system mechanism to improve the regular operation of the system. Further, it develops job functions, and an improved system workflow is modelled. This approach provides the opportunity and eases to expand the business to more service point to reach the customer.

2.1.3 Technology Infrastructure

The main function of this block is to provide and establish smooth technology infrastructure along with the service and maintenance, implementation, and procurement of hardware, provision of attractive downloadable Apps of software, configuring databases for queries, connection to network without any denial of service, and providing interactive web media interfaces with touch screen and assistive technology setup.

2.1.4 E-Business or E-Booking System

This block is a central part of the whole system also known as E-Booking Engine. This is a processing function which takes inputs from business management, organization operations, and technology infrastructure. Performing with zero denial of service to business, advertising the features, and providing sales promotions as push technology.

2.1.5 Service and Return on Investment

The output of the system is a service to the user or customer as well as a nominal return on investment ROI. The aim of the business here is an increase in revenue with continuous profitability.

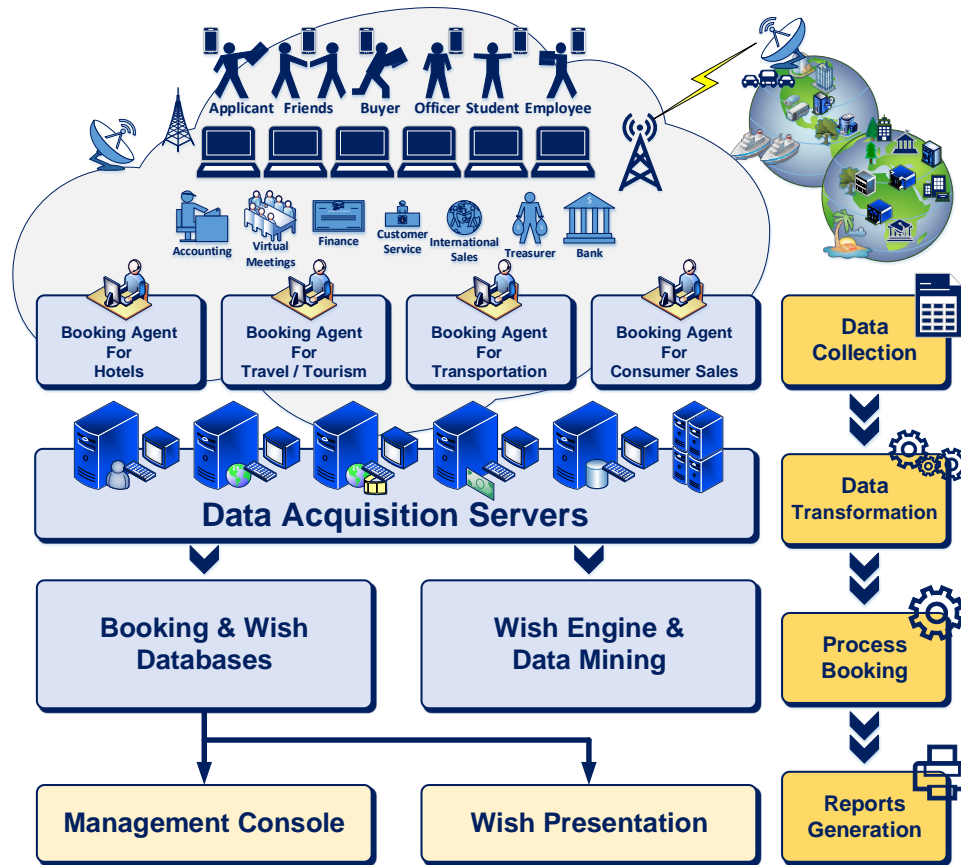


Fig.3. Internet-based e-Booking Engine (IBE) Design Architecture.

2.1.6 Feedback as Business Challenges

In order to provide improved service, the feedback plays a vital role which helps to rectify customer or service criticism improved through business management prior to again input to the process function of the e-Booking system. The main challenges are controlling setup costs and facing the competition of other competitors.

3. E-Booking Engine Architecture

The “Internet-based e-Booking Engine” (IBE) is an application that helps the travel, tourism, transportation, hospital, bank and all types of service industries with support of booking service e.g. flight reservation, taxi or bus ticket, ship, stadium match ticket etc. through the internet via mobile phone or computer or from phone call. It helps consumers to obtain such services online without leaving home [6] [12].

This provides a global computerized booking and service reservation via the internet with a single point of access i.e. via mobile phone to book a flight, hotel, car, a product from the superstore, pay utility bills, order food etc. or via service mobile agents online. For example in the case of a hotel, the

customer can select the best hotel in a prime location with modern facilities, clean environment and having affordable rates [19]. In comparison to this, it can be much time-consuming or wastage, sometimes costly when doing this by self approaching physically or via physical service agents or broker. The rise of internet or www i.e. world wide web has revolutionized the way of communication between customer to customer, business to business, and business to customer or vice versa. The communication and transit which usually took weeks and months became a possible matter of a couple of seconds globally. This technology has grown drastically with the inventions of smartphones, PDAs, and similar devices known as computers. The wireless technology gave further value to this communication that now business is done on the users’ fingertip. This has made ease to develop WebApps and MobileApps software with various objectives to facilitate human more effectively. With this background in mind, we have proposed a digital tourism agency, the customer is allowed to book travel from any place and at any time with own selection of service with a better choice in the shortest time [20] [21] [22]. Fig.3 shows the Internet-based e-Booking (IBE) Engine Design Architecture.

The e-Booking system workflow model is comprising of phases with the sequence of data acquisition, classification and categorization, descriptive analysis, and reports

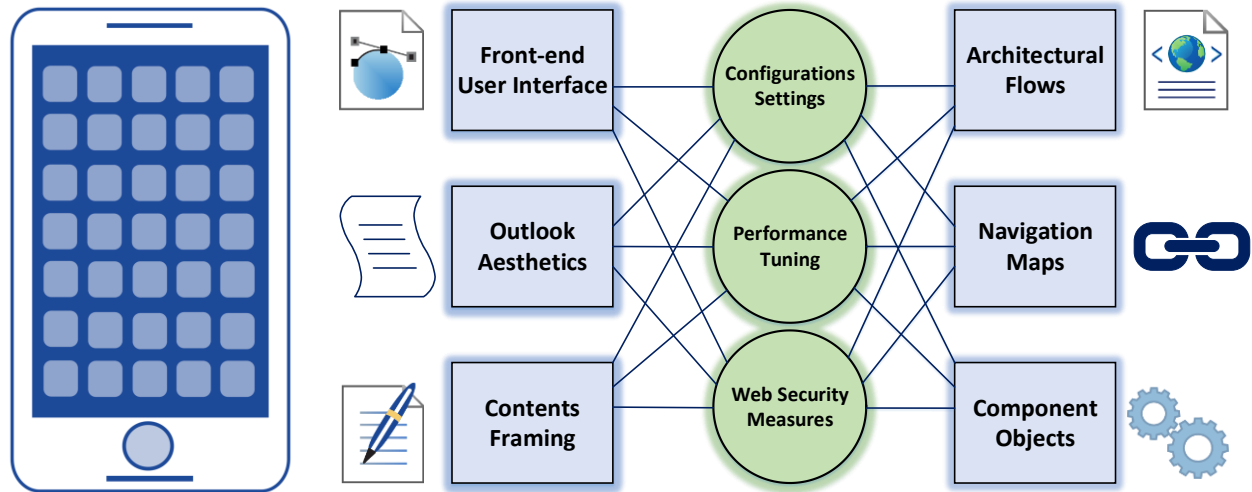


Fig. 4. The design model for WebApps and MobileApps for IBE.

communication. The collected data usually is un-structured, ranging with wish presentation of business and customer. Keeping in view the objective and subjective analysis of data, the data filters are applied to make it categorized and classified in groups. This became now easy to understand the dynamics of descriptive graphs with the provision to accommodate community or customer wishes. The natural language processing, the content of speech recognition, and advanced artificial intelligence techniques are used at customer help sites. The graphical views of this data provide the results to offer a promotion on sales and services [23] [24] [25] [26].

4. E-Booking WebApps/MobileApp Design

4.1 Design Considerations & Quality Focus

As it is described earlier that Social Web requires connection to the objects via some network technology, where user access interface of the software application is indeed needed. Usually, WebApp or MobileApp software tools are utilized. These tools are designed having the consideration of web science methodology with the concept bearing of Sociology, Computer Science, Economics, and Formulation via Mathematics etc. Since Web Science formulates research from disciplines with diversity; constituting Sociology, Computer Science, Economics, and Mathematics etc. [27]; All such ingredients are followed in design.

The quality of a WebApp/MobileApp should be considered in terms of the metrics of efficiency, reliability, functionality, usability, scalability, maintainability, security, and time-to-release. The characteristics of simplicity, consistency, robustness, visual appeal, identity, and navigability are the key concerns and should be focused on keeping the social concerns in considerations [28] [29].

4.2 Nine Design Consideration Focal Areas

Nine different areas are mainly focused while designing of WebApp or MobileApp of E-Booking App. These are (1) Front-end User Interface, (2) Aesthetics, (3) Content framing, (4) Architectural Flows, (5) Navigation, and (6) Components. Besides these, the technology for (7) Configuring web/mobile setup, (8) Performance tuning, and (9) Security; are also kept in mind. The best and systematic approach to design Web/Mobile App i.e. Object Oriented Hyper Media Design (OOHMD) method is followed. OOHMD recommends a systematic process for designing of an abstract interface, conceptual view, navigational map, and the deployment visuals. Fig.4 describes the design model for WebApps and MobileApps for IBE.

4.3 Design Descriptions

The front-end User Interface (UI) design covers structure with the organization of UI with the inclusion of screen layout, detail of mode of interactions, and some detail of navigation mechanism. The outlook or graphic design i.e. "Aesthetics" best described as "look and feel"; including object colour schemes, shades, contrast, brightness, geometric views, text size and colour, font style, and their placement along with picture images is considered. The content of any WebApp/MobileApp is considered highly sensitive since carelessness creates a lot of confusions. Therefore while designing Contents; it's framing layout, structure, the outline of content objects, their link associations and relationships with the primitive of browsing for the basis of navigation, are considered. While designing web architecture a hypermedia structure is designed in either or mixed forms of linear, hierarchical, network, and grid structures. The web infrastructure is then associated with content layout structure with proper configuration keeping in mind the ease of navigability to achieve the purpose of

that Web/MobileApp. All such principles are incorporated. The navigation design focus is set on navigation and surfing flow between every content objects to achieve the main function of that Web/MobileApp. The navigation semantic units are developed having characteristic information of that object with defining multiple ways of navigation, with links and nodes associated. A navigation syntax is also developed to follow the web mechanism as part of semantics. The detailed design of logic processing is considered an integral part of the component to be designed so that component becomes configurable as per fitness, and fully functional [6] [30].

5. Distributed Computing and Data Mining Approach

Depending on the type of problem, there are many competing data mining methods. A general consensus seems to emerge to recognize that no method outperforms the others because they have all their specific strengths and weaknesses. It seems more advantageous to collaborate with methods. Data mining is the heart of the process engine. This phase uses multiple methods from statistics, machine learning, pattern recognition, and data visualization [12]. These methods can be divided into three categories:

1. Visualization and Description Methods
2. Classification and Structuring Methods
3. Explanation and Prediction Method.

5.1 Visualization and Description Method

The purpose of these methods is to allow the data scientist to have a synthetic understanding of all data collected. It is, therefore, the synthesis of information using tools and techniques. This synthesis can be expressed by statistical indicators which include the methods of graphical representation. The diagram in Fig.5 represents a data mining process oriented towards visualization and description of data in the form of graphs and reports. The data is usually collected in the form of tables and relations and stored in spreadsheets. After applying data mining techniques, the graphs could be generated to read the

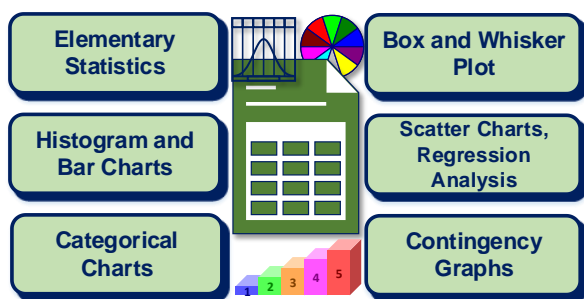


Fig. 5. Data visualization and description.

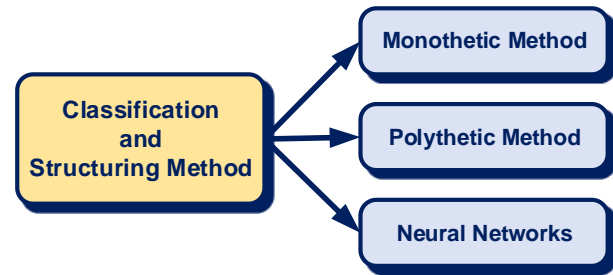


Fig. 6. Data mining classification and structuring methods

conclusions. Such graphs show the elementary statistics i.e. pie chart, distribution charts, histograms, bar charts, categorical charts, box & whisker plots, scatter charts, regression analysis, and contingency graphs. These graphs then became useful to predict the state with conclusions [31] [32] [33].

5.2 Classification and Structuring Method

The purpose of data classification and structuring is to identify the groups of similar characteristics based on their similarities according to some given metric e.g. clustering. These methods use unsupervised learning since the user don't know a priori which classes, groups, or categories will be associated. The main techniques are divided into three groups as mentioned in Fig.6. These methods are (1) Monothetic method, (2) Polythetic method, and (3) Neural Network method [7] [31] [32] [33] [34].

5.3 Explanation and Prediction Method

These methods make it possible to predict whether an element is a member of a given group or category because they use supervised learning. The process of these methods has two steps: (1) The first step is to construct the model from the learning set, and (2) the second step is using the model, which allows to test the precision of the model and to use it in the classification of new data [32] [33] [35]. Fig.7 shows some of the methods used in data mining for explanation and prediction, e.g. Decision Trees, Regression methods, Association rules, Bayesian networks, Genetic Algorithm, and Neural networks etc.

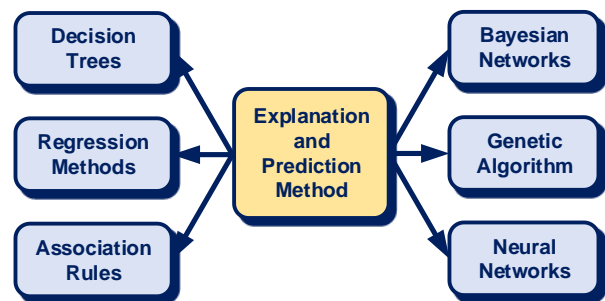


Fig. 7. Explanation and prediction methods.

6. Business Intelligence and Data Analytics

Business intelligence (BI) sometimes interchangeably called business or data analytics to provide data scientists with the predictive model and inference obtained through data mining techniques for taking key business decisions [9]. Understanding the importance and potential of data analytics, many brands and organizations have begun to invest a lot of resources in them. However, most of these data analytics are limited to information boards and reports, while the field of data analytics and data science is large and it has many potential opportunities [11].

The main objective to set big data infrastructure setup is to provide an effective solution to an organization with efficient future business prediction. Big data analytics handle a large number of transactions that are generated and processed related to the organization and provide tabular reports as per view required. There are several examples of multinational enterprises which have opted big data analytics infrastructures. For example Amazon Inc., Alibaba Group Inc., Google Inc. etc. It is also well known about such companies that they view customer profile and surfing behaviour, and then push the product or service promotions as a business offer to them. The advanced artificial intelligence, machine learning, and data mining techniques are used to extract data e.g. text analytics, predictive analytics, descriptive statistics, and natural language processing, etc. The features such as to merge old i.e. historical data, with new one have provided a better impact on results. This helped data scientists to determine the hidden business patterns, multiple correlations, user's hidden preferences, and abstract market zones to set up new avenues of business. Further, this intelligence strengthens the enterprise to lead the market more effectively with timely product marketing, timely introducing product promotions and provide better customer services [36].

6.1 Big Data Challenges and Issues

As compared to a simple large database, big data is considerably multiple times larger i.e. gigantic in size and volume distributed database, which is a challenge to handle with considerable issues over utilization. New methods and technological solutions to Database management system (DBMS) software for processing query and access as well as network infrastructure are required. It is very difficult to handle such a mechanism to generate the query, to process the query, to extract the concerned results, and to analyse the results for further presentation. The existing traditional query system doesn't function. Some new data mining algorithms are needed. Despite these are the issues and challenges, big data is much useful to provide optimum accurate results for decision making benefitting the business ventures [37] [38].

6.2 Storage and Processing Issues

Putting efforts to capture whole and more consolidated information; the best and accurate decision to market and generating revenue is expected from data scientists. The infrastructure setup becomes a challenge and costly, where usually cloud-based services provide the option. The main issue is uploading and downloading of Terabytes and Exabyte of data on day to day basis on a cloud server, which takes large processing time. However, the data extracted by analytical tools and again uploading and synchronizing the update is also a challenge as the data has a dynamic nature i.e. changes and variations are so rapid in comparison of upload and download time. On the other side, the wireless infrastructure of a cloud is distributed geographically becoming problematic to cover all locations to judge the nominal source of data. Therefore the capacity and performance issues are compromised where cloud storage also leads to data security problems. Thus many security models are world-wide proposed [11] [36] [38] [39].

6.3 Analytical Challenges

Big data brings blessings as well as a disguise. It is a capture of every information about an entity or process or event but along with it bear some huge analytical challenges. Main challenges are reforming the unstructured data and aligning the semi-structured data. However, the collected structured data require extensive parallel processing synchronous analytical algorithms co-incident with a time base, to provide quality data with the consistency of information. The Exabyte of data is very difficult to handle. The credibility of analytical process execution is also worth to determine the usability of results in decision making. If the processed data is not used or never used for any decision making, the huge amount spends on developing an algorithm, the time to process and produce results, and the infrastructure used will go wasted. So it is quite advisable to use any one techniques among two i.e. either (1) incorporate the massive volume of data to process and produce analytics, or (2) Credibility of decision should be analysed prior to process the big data since it costs high [38].

7. Conclusion

With the advent of the electronic social web and the global reach of the customer to market or enterprise business has changed the world in a couple of decades. Evolution of data science, machine learning, artificial intelligence, and other scientific fields have supported the business to go electronically with improved business strategies, and well design of application architecture. The need for a customer to access the market could be fulfilled only with the solution of e-commerce web.

Going more specifically people wish to book tickets of the match, or book hotel room, or book flight, or book the food and table in a restaurant etc. require electronic business venture. The solution that has been provided in this research is a novel intelligent electronic booking framework for e-Business with distributed computing and data mining support. There is a concern of big data which allow data scientists, researchers and business users to draw effective, efficient, and timely decisions using reports extracted from big data. There are several issues and challenges to handle such huge data. There is an opening in the evolution of data science, web science, distributed computing, and generation of more enhanced algorithms of data mining, which are the focus of the market today and support is visible in upcoming future. This research concludes that:

- The business framework is required to be redefined to incorporate technology compatible with business policies and as per the comfort of customers with the focus on high return on interest with the provision of quality of service.
- There is a need for software-based electronic WebApp or MobileApp to operate as an electronic booking agent with the framework of global compatibility which should be accessible from anywhere on earth.
- The latest scientific methods are required to be incorporated to enhance the software tool. Such methods belong to the evolving discipline of web science, data science, big data, artificial intelligence, and machine learning.
- Rich data processing machine as well as the expertise to handle huge databases is rare and required.

Further, a new framework for electronic booking system is introduced in this research. The framework is based on wish engine with data mining method and process of booking for finding the optimized results of analyses for the optimal decision which helps to improve advertising and promotions of the product and add new services.

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