

Web Service based Data Dissemination Technique for Education System

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Abstract — Data dissemination includes data reporting in different formats and dissemination of reports. The data to be disseminated is reported in annual digests in both printed and electronic ways by the EMIS. The predefined reports are available for end users that can be downloaded in HTML or PDF format, which cannot be directly used in analytical applications for further analysis. Additionally, reports can also be downloaded in a format that can be used in analytical application for further analysis, but it requires skilled staff to segregate the desired data from the complete report. Our technique uses web services for data dissemination which provides two interfaces to disseminate data: ClickView interface and WebService interface. ClickView interface provides options to generate customized reports based on the attributes selected by the user along with the choice to view or download the report. Web service interface allows the application to application data transfer, regardless of the compatibility of the programming language and network at the both education system's and the end user's end. As a result, it does away with specially designed client application and connecting strings for database connectivity. We illustrate our web service based technique with a case study and findings to disseminate data for higher education system.

Keywords- Data Dissemination, Education Management Information System (EMIS), End users, Web Service, WSDL

I. INTRODUCTION

Education system uses Education Management Information System (EMIS) to manage data. Management of data includes data collection, processing, reporting and dissemination. In this paper we focus on dissemination of data for education system. Education system processes data in several reports for districts, states or institutes which includes complete data related to teachers, infrastructure, students, courses and the like. Data is reported in different formats to view or download. To view, reported data appears in HTML or PDF, which cannot be edited. Data for downloading is provided either in PDF or Excel for end users. Moreover, downloaded reports in PDF cannot be used for further processing work directly. Besides this reports contain abundance of data, which is not always required by end users. Sometimes end users only need to view data or want specific data, but there is no such provision present in the current system. In addition, education system

provides facility to transfers data directly from application to application for selected users. In current system, for application to application data dissemination, applications at both the ends i.e. EMIS and end user's should be compatible. Database drivers and connecting strings are required to connect databases at both the ends. Computing platforms and network are also required to be same. To make data transfer possible after any change in application at EMIS end, end users need to update their applications and database connectivity code every time. Such arrangements increase the cost and time for application to application data dissemination.

Here we propose data dissemination technique for education system using web service. Our technique disseminates data for different types of end users, like, general information gatherer, end users who need data for further processing and those who need data in their analytical applications for planning and policy making process. The proposed technique has three main components:

- ReportGeneration,
- QueryDefinition and
- CacheGeneration.

ReportGeneration component first identifies end users and divides them in different categories according to their requirement of data. Then it assigns report styles for each category of end users followed by providing access rights to retrieve data. **QueryDefinition** component works using two interfaces: *ClickView* and *WebService*. In *ClickView* interface, attributes are provided to end users for designing their own reports. In *WebService* interface, predesigned reports are provided, which, on selection shows WSDL. WSDL is required to be consumed by end users in their applications for direct data access from EMIS application to their applications. To retrieve results faster than the retrieval process of current system, we are using database cache. Query fired from **QueryDefinition** component, checks for the data in database cache. If data is not available in cache, then data is retrieved from database and stored in cache for further identical queries.

In order to find the keys to limitations of application to application data dissemination, our technique uses web service. Web service will fetch results from database in XML, which can be accessed by any programming language [3][5]. Moreover, it can easily be consumed by using web service client applications of different programming languages and

platforms [5][8], which provides application to application data access for heterogeneous environments. Database cache is used in our proposed technique to fasten the result retrieving process. Data access using web service takes more time than web application, but the use of cache increases speed for web service data access many folds [14]. Advantages to use the proposed data dissemination technique are: end users are provided with selected data rather complete reports of a district or a state, introduced database cache for faster access, data can be viewed & downloaded in user friendly formats, web service based application is self-contained which is reusable and easily accessible. This paper has introduced web service for education system which has done away the compatibility and heterogeneity problems.

The paper is divided in 6 sections. Section 2 reviews the literature and section 3 discusses issues of data dissemination in education system. Section 4 presents the architecture of web service based data dissemination technique for Education system. Section 5 describes a case study and findings of proposed data dissemination technique. Finally, section 6 concludes the paper followed by references.

II. RELATED WORK

Education system manages the EMIS to collect, process, analyze and report data. Different report formats are being used for disseminating educational data [2][4][11][12]. Data is analyzed and reported in yearbooks, annual reports or online reports along with posters or booklets to disseminate specific information [4][12]. Education system disseminates data using online method, like web site, where end users can view or download complete yearbooks or reports. According to [17], web service has not been used for the education management system.

Web service based access is being used for several domains. A number of web services have been created for different datasets, which can be easily accessible by other government applications directly [1]. YEASTRACT has used web service to access database for making data available to end users by querying and retrieving process [6]. British geological survey has used web service to allow access of geomagnetic data, which has reduced development time also [7]. National water information system [9] also uses web service to disseminate data. To provide access for environmental data, Brazilian weather forecast and study center (CPTEC) uses web service. Use of web service has made data available on internet. It can be easily accessed by end users and moderate knowledge is required to retrieve data directly from application to application [15]. Geospatial data dissemination by Bhuvan (ISRO's geoportal) [18] is also using OGC web service to provide interoperability among distributed geospatial databases. Biochemical reactions and kinetics rate equations are made available using web service interface by SABIO-RK information system. They have both web application and web service interface to provide access to data and found web service interface delivers data faster than web application interface [20]. E-learning domain has provided modules as web service which can be accessed by any user worldwide [10][13][19].

Here, we use web service for data retrieval along with database cache to provide data in user friendly formats in the education management system.

III. ISSUES IN DATA DISSEMINATION

Reporting formats used by education system to disseminate data are inadequate for different categories of end users. Data reported is same for districts, states, teachers or students, which, can either be viewed or downloaded or directly transfers to specially designed applications for end users. Few issues in data dissemination are listed as follows [17]:

Every end user has different requirement yet they have to download pre designed reports, which contains data in abundance. There is no provision to select data for end users to retrieve required reports.

Data is provided in PDF or HTML formats for all categories of end users. These reporting formats cannot be edited, thus cannot be used directly in further analysis using analytical applications.

Direct data access from application to application is provided for limited end users by using specially designed applications for both the education system's and end user's ends. Special hardware and software have to be installed to have compatibility in computing systems and database at both the ends.

With every update in application at EMIS end, requires updates in end users applications as well. Such technical arrangements require professional help. As end users are geographically spread all over the country, maintaining direct data transfer is a tedious task. In addition to this, it is time consuming, which may delays planning process.

Here we are presenting a technique to disseminate data with web service interface which facilitates selection of required data and return type. Use of web service in application to application data transfer has solved compatibility issues. No change is required in computational environment and data can be easily transferred from application to application directly using web service interface.

IV. WEB SERVICE BASED DATA DISSEMINATION TECHNIQUE

Web service based data dissemination technique disseminates data to all end users according to their requirements. The proposed technique, first, identifies end users for different categories, then, assigns reporting styles and access rights. We have used two interfaces for data dissemination. In first interface, attributes can be selected to form queries for retrieving results in assigned reporting styles and in second interface, predefined reports as web services can be selected for direct data transfer. Database cache is used to provide fast delivery of data to end users. We have identified three categories of end users, as follows-

- *Guest*– Users who need general information, like, students, teachers, parents etc. They can only view the data.
- *Registered* – Users who need data for further analysis and planning purposes, like, schools, Universities etc. They can view and download the data.

- *Privileged*– Users who need to further process the data using other analytical tools. Application to application data transfer is required by the user, in addition to view and download.

Figure 1 shows overall architecture of our technique. Proposed data dissemination technique is divided in three components:

- ReportGeneration
- QueryDefinition
- CacheGeneration

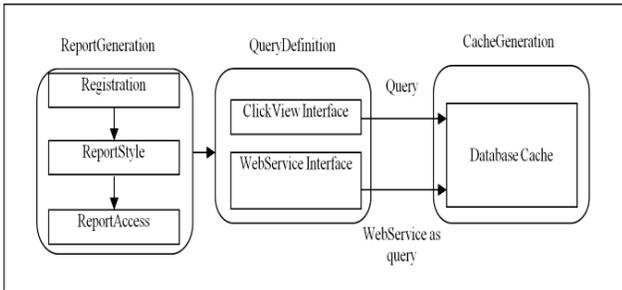


Figure 1. Overall Architecture of data dissemination technique

ReportGeneration- This component generates reports in different formats for all categories of end users. First of all, this component registers the end users and categorizes them. After registration, report styles are assigned to end users based on their categories. Depending on the assigned report style, this component provides access rights to view, download and for application to application data transfer. This component works in three phases:

- Registration
- ReportStyle
- ReportAccess

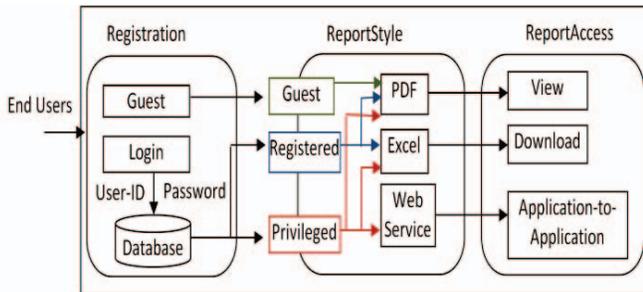


Figure 2. ReportGeneration Component

Registration phase allows the user to register in two ways - **Guest and Login**. In Guest, our technique does not require User-ID and password from end users. Any user as a Guest can use our technique only to view data. Guest is directly provided with data access interface. In Login, our technique requires user-ID and password from end users. On receiving User-ID and password, verification is done, where they are verified from the datasets stored in the database, as shown in Figure 2. After verification, the end users are further categorized as registered and privileged users. These categories are the input to the Report Style phase.

ReportStyle provides three types of report formats on the basis of input received from Registration phase. Registration

phase gives three categories of end users i.e. Guest, Register and Privileged. Guest, who need data for general information is allowed to view reports in un-editable format like, pdf. Registered users are provided with reports in spreadsheets, like, Excel that can be edited. Privileged users are allowed to transfer data directly from application to application in addition to pdf and spreadsheet report styles.

ReportAccess provides access rights to end user on the basis of report style phase output. Our technique provides three report styles for different categories of end users. As each category of end user has different purpose to access data, they are given report access rights accordingly. Report access rights to different categories of end users are as follows:

Guest, who needs data for general use, can only view the reports. Data is reported in either PDF or HTML, which can only be viewed. These both the report styles cannot be edited directly and used for further process.

Registered users are provided with PDF and Excel report styles as an output of report Style phase. PDF reports can be viewed but cannot be copied or edited and reports in Excel can be downloaded and edited for further analysis work.

Privileged users are provided web service reports in addition to PDF and Excel report styles as per report style phase. Web service reports are provided to users for direct data transfer from education system’s application to their analytical applications. WSDL of web service is available for users on the selection of web service reports. Privileged end users are required to consume WSDL of selected web service report for direct data access. Thus, privileged users don’t have to change their analytical application for direct data transfer. They are also done away with database settings and network compatibility.

QueryDefinition component defines queries for data access. This component provides two interfaces – (1) select attributes for designing queries, and (2) select predefined queries as web services reports according to end users requirements. Complete reports are not always required by end users, so this component defines end user’s customized reports. Two interfaces are as follows:

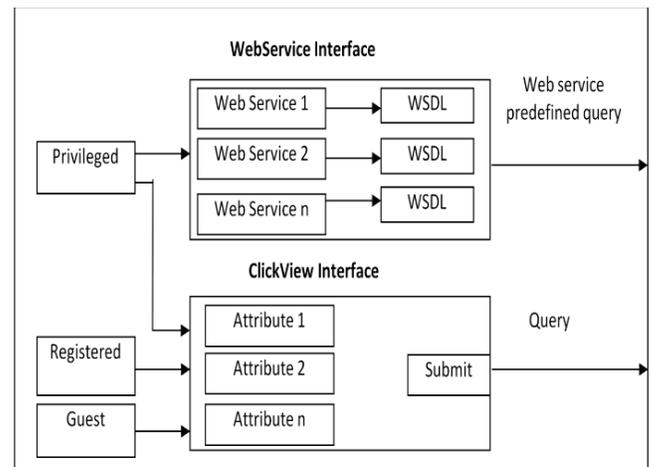


Figure 3. Query Definition component

ClickView interface: This interface provides designing of query on the selection of attributes by end users. Guest and registered users are required to select attributes as per their requirements. On submission of the query, the query is designed and the result is fetched accordingly for the end users, as shown in Figure 3. This interface also provides selection of reporting styles for registered and privileged end users to view or download reports.

WebService Interface: This interface uses web service for providing data. In this interface, a list of web service reports is provided with their WSDL. Selection of web service triggers predefined query to fetch results as shown in Figure 3. Reporting styles are also provided in three formats for this interface: view, download and application to application data retrieval. For application to application data retrieval, end users are required to consume web service (for which WSDL information is provided) in their applications. Thus, they can access data directly from their analytical applications without recoding of entire application. There is no need for compatibility of systems at both the ends to access data directly.

CacheGeneration component delivers results corresponding to the query designed from QueryDefinition component. This component takes input as the queries formed through ClickView interface or Webservice interface.

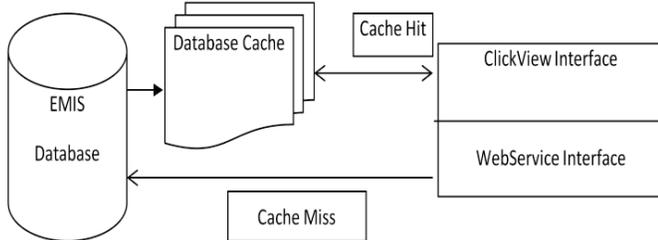


Figure 4. CacheGeneration Component

ClickView interface forms general query which retrieves results from database cache. If query is new and data is not available in cache, the data will be delivered from database and stored in cache for further similar queries as shown in Figure 4.

WebService interface provides predefined query for which results are stored in database cache for faster delivery of data. Database cache is introduced here to provide faster access to end users as accessing data from cache takes less time as compared to long process of querying database every time. This component is coded for automatic updates, so that data delivered from cache is the updated one.

V. CASE STUDY AND FINDINGS

Education system manages data to provide information about educational institutes under government and private aegis, like, schools, colleges, technical institutes, universities etc. We are implementing our technique for colleges in Delhi region. For the case study, we have collected data from five colleges with the help of web service based data collection tool [16] and stored in the database. End users are provided with two interfaces to retrieve data: *ClickView* and *WebService*

interface. This technique identifies three categories of end users:

- *Guests* (parents, students, researchers, NGOs etc for only view the data)
- *Registered* (end users who have been provided user name and password to login the system for view and download data)
- *Privileged* (educational institutes, district or state offices, policy making and planning departments etc for direct access of data from application to application)

Reports are provided in non-editable and editable formats for the ease of end users. For Guest, format to view and for registered both view (PDF) and download (Excel) formats are provided as shown on Figure 5. Web service reports are provided for privileged end users for application to application data transfer in addition to PDF and Excel formats. We have also introduced database cache for faster retrieval of both general or web service reports as compared to direct access from database. For direct data access, WSDL information of web service is provided to privileged users, which they can consume in their applications for direct data transfer.

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Figure 5 Report formats to view, download and direct data transfer for Higher Education System

For guest, reports are provided in PDF, registered users have been provided PDF and Excel both and for privileged users web service reports are provided. As you can see in Figure 5, a list of web service reports are also provided on an interface. Privileged users have given access to Webservice interface for application to application data access and where WSDL of selected web service is provided. End users need to consume WSDL in their applications to access data directly from education system's application to their applications. For application to application data access, end users need not recode their applications entirely for compatibility issues. WSDL is complete information about web service which can easily be consumed by end users in their application irrespective of heterogeneity of computing systems.

From implementing of our technique for disseminating college data, we can say that our technique provides better data

dissemination methods for education system. We have compared our technique with current data dissemination process of education system as shown in Table 1.

Table 1 Advantages of proposed data dissemination technique over current data dissemination technique

Parameters	Current Data dissemination Technique	Proposed Data Dissemination Technique
Ease of Use	Data in PDF and HTML, not editable	Data in Excel is editable
Selection of data	No Selection of data – complete reports to be downloaded	Data can be selected for required information
Selection of reports	Reports available in predefined styles, like, HTML, PDF, Excel	Reports available in three styles with choice to end users
Application to application data transfer	Specially designed applications required at both education system's and end user's ends	No requirement of specially designed applications as web service can easily be consumed in any application irrespective of the languages used
Compatibility of computing systems	Compatibility of computing system's and database required at both the ends with connecting strings.	No need to have compatibility of computing systems and database as web service interoperability properly provides communication between heterogeneous computing system.
Maintenance in application to application data transfer	Any change in education system's application or database need modifications at all end users applications	Data transfer with web service has done away the need of updating of system due to change in education system's application

Proposed data dissemination technique provides data in reports of different styles favourable to end users in addition to direct data transfer from application to application. Table 1 shows advantages of our technique over current data dissemination system. End users can view or download only required data in user friendly formats which can be edited for further process. More end users categories and report styles can be added easily. End users need not download or view

complete reports as they have been provided an interface to design their own reports according to their requirements. Findings of our proposed technique are listed below:

- Interoperability: With the use of proposed technique, data can be transferred in heterogeneous networks.
- Deploy-ability: No special arrangement is required as web service can leverage web standards.
- Interpretation: Use of SOAP has made easier to use services and interpret messages.
- Flexibility: Data is disseminated in several formats to that can be directly used in analytical applications for further processing.
- Dependability: Applications at education system's and end user's end are independent of each other. Change on any end will not affect other end.
- Green Computing: Data is transferred directly in dissemination from application to application, thus supporting green computing.

In current data dissemination system, specially designed application needs to be installed with database and connecting strings but proposed technique uses web service for application to application data transfer. Any change in education system's application needs modification at all levels of administration for direct data access, which is time consuming and need professional help. In proposed technique, application to application data delivery can be done by using WSDL information. End users are only required to consume web service in their application. There is no need of special software and hardware installation for application to application data access. Use of web service has done away with installation cost, cost of professional help, thus, reducing overall data dissemination cost. Ease of use has increased with the use of web service and end users can retrieve required information by using our technique.

VI. CONCLUSION

Data is disseminated in fixed formats as reports to view or download, that cannot be edited for further processing. Disseminated reports are same for all categories of end user which contain abundance of data which is not always required by end user. Thus, extracting required information is time consuming. Data is also disseminated directly from application to application for selected end users. For direct data transfer, EMIS designs special application with database compatibility which is required to be installed by end users to access data. For direct data transfer, special computing infrastructure and professional expertise is required at both the EMIS and end user's end. Few limitations, like, end users has no option to select required data, reporting formats cannot be used directly in any application for further analysis, increase in cost of setting up homogeneous computing system at all levels of administration, updating end user's application with every update and any change in application needs recoding; has increased cost of data dissemination. In this paper, we propose data dissemination technique with web service interface to disseminate data in different formats to view, download and application to application data access. The use of web service reduces the cost of development and infrastructural

requirements, which is discussed with the help of comparison table between existing and proposed data dissemination technique.

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