EwayDataDiss: Web Service-based Data Dissemination Tool for EMIS

Ruchika Thukral, Anita Goel, Sheetal Taneja

Department of Computer Science, University of Delhi, New Delhi, India

ruchikathukral2203@gmail.com, goel.anita@gmail.com, sheetaltaneja1@gmail.com

Abstract

Education Management Information System (EMIS) disseminates the data in two ways - the user can click and retrieve the data and the user can perform an application to application data transfer. Click and retieve data dissemination facilitates end users to view or download preprocessed data as reports.The reports are generally predefined and the user can hardly design the report according to their requirement. Moreover, the generated reports are in non-editable formats and, thus, cannot be directly used for further analysis. Application to application data transfer allows direct data transfer from the EMIS to the end users application. Web services facilitate direct data transfer among the heterogeneous systems. In this paper, we propose EwayDataDiss, a tool which uses web services for education data dissemination. For application to application data transfer, the reports are defined as a set of predefined web services. An authentication mechanism is provided based on which the retrieved reports may be in editable format. For retrieving data, the end user can select atributes to generate their reports. Here, we discuss the EwayDataDiss's architecture, implementation and compare its features with the existing EMIS.

Keywords: *Education Management Information System (EMIS), Database Cache, EwayDataDiss (proposed data dissemination tool), End Users, Web Service, WSDL*

1. Introduction

Data dissemination in education system generates reports based on the data collected from the educational institutions. Data is distributed as online reports through Education Management Information System (EMIS) website. EMIS disseminates data in two ways where end users can click and retrieve reports, and application to application for direct data transfer. For retrieving data on clicking, predefined reports are available for end users that can be viewed or download in different formats. Application to application data dissemination transfers data from the EMIS to the end user's application, directly. However, for such data transfer client applications are designed, which, are required to be installed by the end users on their computing machines. The user also needs to install the compatible database with the desired connecting strings to enable direct data transfer. Moreover, all client applications need to be modified with every small change in EMIS application.

In this paper we propose EwayDataDiss, a tool to disseminate data which uses web services for education system. It provides data in different formats, as per the end user's requirement. The tool allows the end users to view or download the data, and also provides direct access to the selected data. Our tool has adopted two ways to disseminate data: 1) Interaction based data dissemination that generates reports on the basis of attributes selected by the end user and 2) Application-to-Application based data dissemination that disseminates data directly to end user's application on the consumption of web service.

EwayDataDiss architecture consists of two subsystems: Report processing and Report generation subsystems. Report processing helps to retrieve results from database and report generation helps to disseminate retrieved results in different formats. Both the subsystems use two interfaces: Select Retrieve interface and Web Service interface. Select Retrieve interface allows end users to select data as per their requirements. Web Service interface lets end users to select from among the pre-defined web services. For faster access to the data, database cache is used with both the interfaces. Web Service interface also provides data in different formats.

EwayDataDiss consists of several components:
- an authentication program that accepts end users login and password and authenticates them
- an assignment code to assign the access rights to the user
- a selection interface for selecting the attributes or the web services for the report
- a report format that provides reports in different formats

The main focus of our tool is to provide data transfer from application to application, using web services. Use of web service in EwayDataDiss has done away with the requirement of compatible computing systems and database for direct transfer of data on the end user's side. Web service interface facilitates data transfer in heterogeneous computing systems. Web service can be consumed by using WSDL information in any application irrespective of the languages and networking platforms. This reduces the cost and time to setup special computing system at both the ends. We have also used cache which has increased the processing speed and reduced the delivery time. Thus our tool is user friendly and can be extended to add any new functionality.

This paper is divided into nine sections. First section introduces the paper and second section explains data dissemination in EMIS. Section three illustrates EwayDataDiss Architecture. Section four and five is about subsystems of EwayDataDiss. Section six tells how to use proposed tool. Section seven describes implementation and findings of EwayDataDiss. Section eight gives related work followed by conclusion in section 9 and in last references.

2. Data Dissemination in EMIS

In this paper we focus on data dissemination in the education system. We have performed a survey of existing EMISs of several countries and identified the problem areas. We found that EMIS do not provide an option to select data for generating reports. Reports are available in predefined formats. Moreover, formats available by EMIS cannot be used directly in other applications for analysis purpose. Direct access of data is available, which, needs specially designed applications at both sides with complete compatibility of computing systems. EMIS application needs modifications at all client applications, which is time consuming. Moreover, it increases the cost and reduces the data transfer speed, thus, affecting overall efficiency of data dissemination process.

We propose to handle the data dissemination issues, by providing users with two kinds of method. First method to disseminate data is interaction based that provides end users to select data and retrieve result in different formats. Second dissemination method is based on

application-to-application data transfer. Here, the end users are provided with a set of web services. On consuming web services with WSDL information, the end users can fetch data directly in their applications as shown in Figure 1.
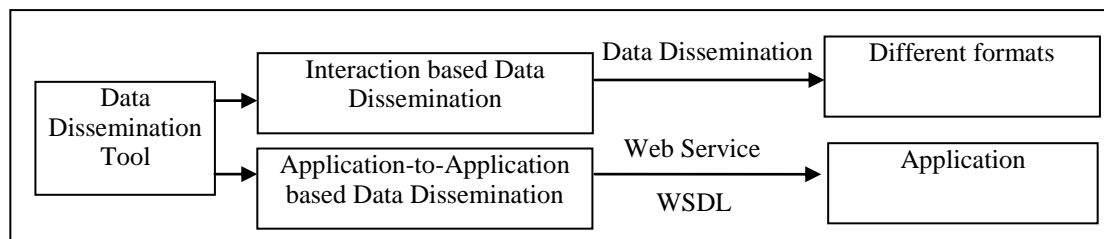
Figure 1. Data Dissemination Methods

We have identified the end users and categorized them as follows:-

- *Guest*: - End user who requires data for general use, like, parents, teachers, student etc.
- *Registered*: - End user who requires data for research purpose, like, researchers, NGOs etc.
- *Privileged*: - End user who analyses data for planning and policy making process. They are provided with direct data transfer.

The Guest does not require a login. However Registered and Privileged users require a login to get the data. The mechanism for disseminating data uses two interfaces. First interface facilitates end users to select attributes and second interface provides set of web services as predefined reports. For every web service, WSDL is provided which can be consumed by privileged end users in their applications for direct data retrieval. Here, the result retrieved by web service reports is in XML format that can be parsed to deliver data in any format favourable to the end user.

3. EwayDataDiss Architecture

EwayDataDiss provides an environment to process and generate reports to disseminate educational data. The tool provides end users with selection of data for generating reports in different formats. Additionally, the tool provides data as web service reports for direct data transfer. EwayDataDiss delivers data in different formats on consuming web service reports result.

The tool architecture consists of two main subsystems, namely, report processing subsystem and report generation subsystem, as shown in Figure 2. The purpose of report processing is to retrieve results on the basis of selection of data or web service. After selection, report processing delivers results based on end users access rights, which is required by report generation subsystem.
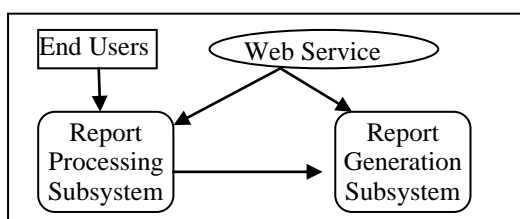
Figure 2. EwayDataDiss Overall Architecture

The processed reports from report processing subsystem are input for report generation subsystem. Report generation offers an environment to disseminate data in different formats. It supports three categories of end users, which, are provided with two interfaces to disseminate data. It supports data dissemination in view or download formats and application-to-application data transfer.

4. Report Processing Subsystem

Figure 3 shows subcomponents of report processing subsystem. Authentication component accepts the login-ID and password from the end user. After verification, assignment component identifies the class of the end user - Guest, Registered or Privileged. Based on the identified class, the report selection component provides end users with two interfaces - SelectRetrieve and WebService interface.
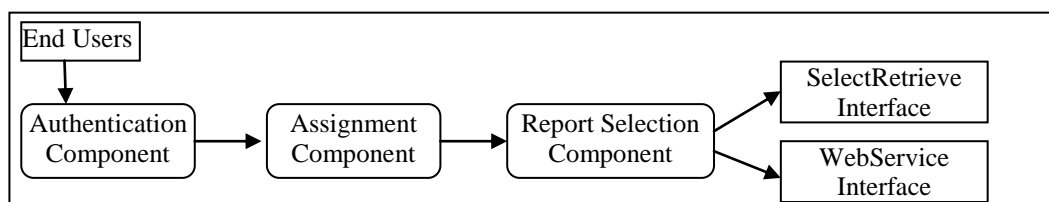

Figure 3. Report Processing susbsystem

Authentication component provides end user with an interface that facilitates two types of authentication process. First is to access data as guest and the second is for registered and privileged end users. Guest end users are directly provided with report selection component, whereas, registered and privileged end users are first identified. For identification, user name and password mechanism is required, as shown in Figure 4.
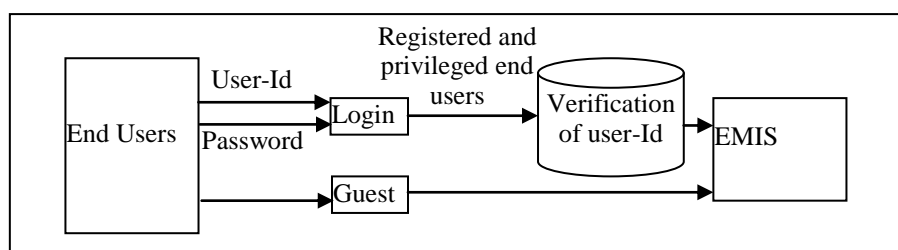

Figure 4. Authentication component

Assignment component categorizes end users and assigns access rights to them. Guest users are guided directly to an interface, where they can select the attributes that are required in the report. Whereas, registered and privileged end users are provided access to *Report*

Selection Component. Guest end users are assigned rights to view the data, registered end users can view or download the data and privileged end users can perform application-to-application data transfer.

Report Selection Component takes the selected attributes or web services as input. This component is further divided in two subcomponents : 1) **SelectRetrieve interface** which provides end user with a facility to select data view and excel format to download. **2) WebService interface** which provides data as a web service to be consumed by the end user. The data is provided as a web-service to facilitate application to application data transfer.

5. Report Generation Subsystem

This susbsystem works during the execution of report access request from the report processing subsystem. The following subsection define subcomponents of report generation subsystem, namely, Selection component and DataDistribution component with two interfaces. End user can select data and return type by using SelectRetrieve and WebService interface. Data is provided as the output of DataDistribution component in different formats with application-to-application data transfer as shown in figure 5.
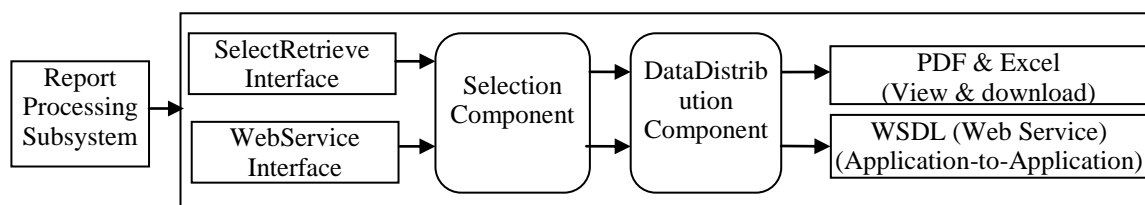

Figure 5. Report Generation susbsystem

Selection Component facilitates end users with selection of data by SelectRetrieve and WebService interface. In SelectRetrieve interface, all the data available for access to the end user is provided in choice mode in the form of check boxes. End user needs to make selection of attributes for retrieving reports in view or download formats. Selected attributes in this interface forms query against the selection that will later be fired to retrieve data from database as shown in Figure 6. This interface is accessible to the Guest with the view option and to the registered end as a download option in addition to the view.
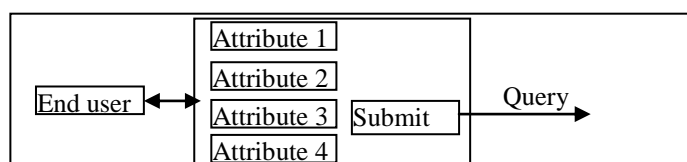

Figure 6. SelectRetrieve Interface

In WebService interface, end users are provided with the selection option to choose from among the various web services. The selection of web service is provided for privileged end users.
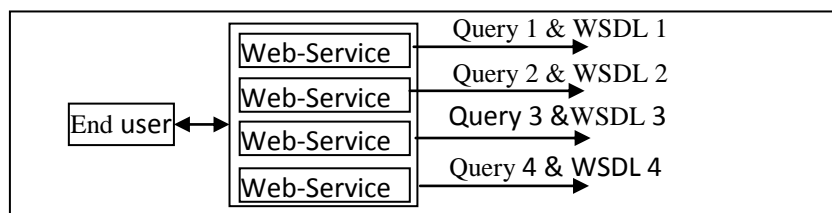
Figure 7. WebService Interface

In the Figure 7, end users are provided with an interface for the selection of web service. The interface provides the end user with a list of web services. For each web service, the query and WSDL is generated.
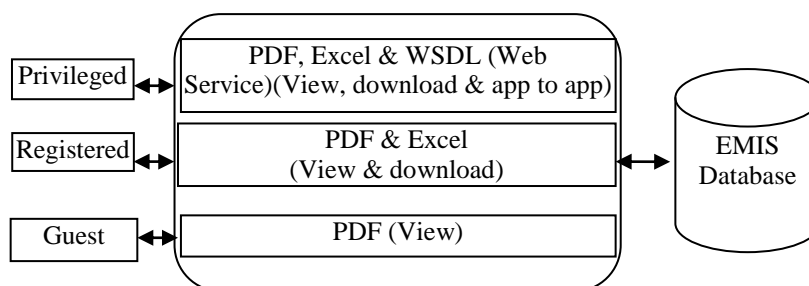
DataDistribution component delivers reports according to the selected attributes and web service for Select Retrieve and Web Service interfaces. The selections made in both the interfaces forms query, which is fired against database cache. If result corresponding to selected attributes is not present in database cache, component will fetch the result from database.
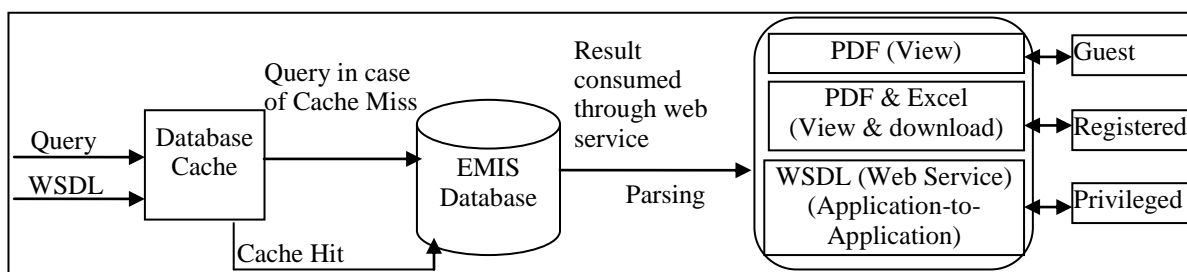
Figure 8. DataDistribution subcomponent

In case of Cache Hit, data will be retrieved from database. The result retrieved is available in different reporting formats on the basis of categories of end users accessing it. Web service report selected in WebService interface by privileged end users is available as WSDL and the corresponding result with different formats as shown in Figure 8.

Figure 9 shows overall framework of Data Distribution component. This component of our tool, deliver results corresponding to the selection of data by different categories of end users in different formats. The Guest end users can view the data, registered end users can view or download retrieved data and privileged end users are also given view and download facility with WSDL information of selected web service for application to application data retrieval.

Figure 9. Overall Architecture of DataDistribution Component

6. Using the Tool

EwayDataDiss tool has two interfaces: Authorization and ReportGeneration. Authorization interface is divided in two components: Guest and Login as shown in Figure 10. End users of Guest can access ReportGeneration interface by using Guest component. End users of registered and privileged categories have to provide login-ID and password to access data using Login component. Once Login-ID and password get matched, end user will be directed to ReportGeneration interface.

Figure 10. EwayDataDiss Login Interfce

Report Generation interface can be accessed by end users once they are verified by authorization interface. This interface is further divided in four sub-interfaces: Guest, Registered, Privileged and WSDL sub-interface.

Figure 11. Guest sub-interface and Registered sub-interface

After login, EwayDataDiss verifies end users and categorizes them as Guest, registered and privileged end users. EwayDataDiss provides three sub-interfaces for ReportGeneration interface. Guest sub-interface and registered interface provide selection of attributes for end users. Guest sub-interface facilitates only to view data, whereas Registered sub-interface provides facility to view and download both as shown in Figure 11.

Figure 12. Privileged sub-interface and WSDL sub-interface

Privileged sub-interface facilitates end users to view, download or applicatio-to-application data transfer. Web service button on privileged sub-interface takes end user to WSDL sub-interface, where, a set of web services is provided for end users. On the selection of web service, coreponding WSDL will bw flashed on the interface as shown in figure 12. WSDL information of web service report can be easily consumed by end user for direct data access. Code to consume WSDL is written below.

Table 1. Code for consuming web service using WSDL

```
require_once('./nusoap-0.9.5/lib/nusoap.php');
$client=new
SoapClient('http://localhost:8080/WebserviceImplementation1/services/CollegeDatabase?wsdl');
```

Table 1 shows consumption of web service using WSDL in PHP. However WSDL can be consumed in any programming language, thus, facilitating application-to-application data transfer in heterogeneous computing systems.

7. Implementation and Findings

The EwayDataDiss tool is implemented using PHP for user interfaces, JAVA for web services and MySQL for database. Bottom-up approach is used to create reports as web service. WSDL will be generated in the process of creating a web service. WSDL can be consumed in any application, irrespective of the language and platform used. Thus, supports application-to-application data transfer.

For our study, we have deployed our EwayDataDiss, for higher education data dissemination. We have taken three data sets to disseminated basic information. Data sets used in our tool are as follows:

College: to provide college name, address, email-id etc
Teacher: to provide information about teacher's qualification or specialization etc
Student: to provide information about student's name, age, courses they have enrolled for
information etc

Test data is taken from five colleges. The data available on web site can be viewed in HTML format or downloaded in PDF format. These both formats cannot be used directly in

any application for further analysis. We have deployed our DDT for disseminating data for colleges. EwayDataDiss categorizes end users in the following classes:

- EwayDataDiss -Guest end users who want to see data to check courses and teachers for admission purposes
- EwayDataDiss -Registered end users who want data for research work by using further analysis
- EwayDataDiss -Privileged end users who want data for planning and policy making purposes

EwayDataDiss uses all the interfaces mentioned in section 6 for data dissemination in higher education system. We have consumed WSDL in our application to view and download data directly from database. Consumption is coded in PHP as shown in Table 1.

On the basis of results retrieved by using EwayDataDiss, we have compared our tool with data dissemination process of other countries from USA, South Africa and Asia. We have made comparisons on the basis of data availability, performance and ease of use and analysed results in tabular format as shown below.

Table 2 Comparison of different Data dissemination Tools in Education System

Parameters/Countries	Ohio	Texas	California	Uganda	India	Republic of South Africa	Pakistan	Proposed EwayDataDiss
Availability of data								
• View	✔	✔	✔	✗	✗	✗	✔	✔
• Download	✔	✔	✗	✔	✔	✔	✗	✔
• App to App	✗	✗	✗	✗	✔	✗	✗	✔
• Statistical Data	✔	✔	✔	✔	✔	✔	✔	✔
• Detailed Data	✗	✗	✗	✗	✗	✗	✗	✔
Performance								
• Editing	✗	✔	✗	✗	✗	✗	✗	✔
• Small Report size	✗	✗	✔	✗	✔	✗	✗	✔
• Ease of Use	✗	✔	✗	✔	✗	✗	✔	✔
User friendly								
• Data Selection	✔	✗	✔	✗	✗	✗	✗	✔
• Report format Selection	✗	✗	✗	✗	✔	✗	✔	✔
• App to App data transfer	✗	✗	✗	✗	✗	✗	✗	✔

On the basis of Table 2, most of the EMIS disseminate reports to view and download. Very few of them provide facility for application to application data transfer. Reports disseminated in most of them contain only statistical data. Very few EMIS disseminate reports which can be edited or further used in analytical applications. Report size of most of the EMIS is very big which takes lot of time to download. Most of the EMIS do not provide easy to use report formats. Very few of them provide data selection facility and report format selection. None of the EMIS has user friendly application to application data dissemination facility. Our proposed EwayDataDiss, a data dissemination tool provides data in all formats which is user friendly and editable. End users can select data, forming their own reports styles which are neither big in size nor slow in downloading. We have used database cache for data retrieval which makes data retrieval faster as compared to other EMISs. In application-to-application data dissemination, we have used web service which has done away the need of compatibility of computing systems at both EMIS and end users side.

8. Web Service in Data Dissemination- Related Work

Data dissemination is processing data and disseminating in different report formats. Education system collects data from educational institutes and store in EMIS. EMIS then processes data and create different reports [1][3][10][11] for districts, states or educational institutes. Data is reported in annual books [3][11] which contains statistical data or other analytical reports. We have performed a survey in [16] for EMIS of several countries where we have found that pre defined reports are available in view or download formats. Application to application data transfer is also available but requires compatibility of computing systems and database at both EMIS and end users ends. We propose data dissemination tool to disseminate educational data. We have studied other data dissemination tools which are using web service for dissemination purpose. To disseminate geomagnetic data for geological survey, British government has used web service and reduced their development time [6]. Environmental data of Brasil and National water information system of USA can be accessed using web services [8][14]. Geospatial data by Bhuvan (ISRO's Geoportal India) disseminated data using web service [17]. Biological data by YEASTRACT and SABIO-RK is disseminated by web service to be read by human and machine directly [5][19]. Web services are widely used for e-learning [9]12][18]. Web service is also used for data collection by us for education system [15]. We are proposing use of web service for retrieving data from data base as done in [2][4] and created web service client to consume functionality of web service as done in [4][7][18] to access data directly. We have also introduced data cache for faster retrieval of data using web service [13].

9. Conclusion

In this paper, we propose a data dissemination tool, EwayDataDiss, for disseminating educational data. Our tool disseminates data as per the user's requirement in different formats. It also facilitates end users with application to application data transfer by using web service interface. Use of web service has allowed data dissemination in heterogeneous computing environments. Proposed tool has increased the overall processing speed and reduced the data delivery time. Also our tool is user friendly and can be extended to add any new functionality. We have performed survey of several EMISs and on comparison, EwayDataDiss, is more efficient than others in performance as well.

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