

Web Technologies In Education

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Abstract

Web technologies are rapidly taking over the traditionally used desktop applications. Depending on the purpose of the use, web technologies can provide more flexible and scalable solutions. In this paper we describe the specific use of web technologies in B&H. IT in the educational field in B&H is still under rise, and several projects have been developed. This paper describes a project called Smart School that has a rise as an alternative to the current solutions available on the market. Smart School meets the requirement set for a stable, scalable and secure application.

1.INTRODUCTION

In order to develop and deliver an application in the educational field few aspects should be taken into consideration. A modern application in education would allow usage by several different groups of users, including teacher/professors, students, administrative workers, head of department and other decision making groups. Web applications provide the ability to build a solution, which can be used from any location and from any device in world. In this paper we describe the information systems used in education for management of student's information, such as marks, attendances, comments and any other resource that can be utilized to track the achievement/progress of a student. In this paper we focus only on solutions used in primary and secondary schools.

For specific examples and comparison, an application already used in education is evaluated, and as it do now satisfy the current needs, a detailed work is presented on an alternative

solution called “Smart School”, which has been developed and is currently used by 8 schools in 4 cantons of B&H. “Smart school” is a web application that manages all school resources, providing access to school employees such as teacher to populate data about a student, and on the other side provides feedback to students and parents. “Smart School” differentiates itself from the other solutions, by having a much easier and friendly user interface allowing simple and fast access. A special commitment has been made in the field of security, where all data is encrypted and passed through secure layers. The security level in “Smart School” is similar to the one used in the banking industry. “Smart School” for the first time in the educational system in B&H introduces the 2-step verification process for the user authentication by utilizing security tokens for generating one time password.

2.CURRENT STATE OF IT IN B&H

Information technologies are constantly emerging in all sectors of businesses in B&H. Many businesses use now the latest technologies and software available on the global market to perform everyday tasks easier, faster and with more quality. This is mainly due to the fact that businesses have to evolve and keep on innovating in order to stay competitive over the competition. Unfortunately this is not the case in the educational sector in B&H. The primary and secondary schools are back behind the use of IT technologies in education. The primary and secondary education on a large base still depends on the traditional way of teaching with the conventional methods.

During the school year 2005, the Sarajevo Canton Ministry of Education, introduced for the first time in B&H, an information system for schools in Canton Sarajevo CS called Education Management Information System EMIS. The purpose of EMIS is to collect data from schools, and stores it on centralized databases. The collected data is used for statistical purposes by the Ministry(UTIC, 2012). EMIS collects all data about a school including the students, staff, premises and school inventory. EMIS offers the possibility to print student transcripts at the end of the school year. In order to achieve the following, schools are entering student marks after the end of each term. Today after more than 6 years EMIS has retain its functionality in Canton Sarajevo. The main drawbacks of EMIS are its limited functionality, where it is just a statistical application, which has the ability to collect data twice a year. This is mainly due to the complicated use of the application and the lack of knowledge by the staff in schools. The Ministry started with the campaign of basic education of teachers in CS just last October 2011(Logosoft, 2011). This campaign included basic education of teachers with the use of Microsoft line of products such as Windows 7 and Office 2010.

Bosna Sema as a private educational institution has recognized the need to elevate the current educational system in B&H to a higher and more quality level. Bosna Sema has 8 primary and secondary educational schools in four cantons in B&H(Bosna Sema, 2011). Following the fact that the primary and secondary schools are mandatory in B&H for all students, the

need to involve even more the parents in the everyday aspect of a school arose. Bosna Sema recognized the need to constantly provide feedback of student's performances and receive feedback from the parents. This private institution has 3 schools in the Canton Sarajevo where it is using and supporting EMIS for those schools. Unfortunately EMIS does not satisfy the needs of this private institution, to provide an educational system that is transparent and able to involve the parents in the process of education. Following these requirements Bosna Sema has started a joint venture with an IT company to develop an application that will meet all of the requirements set for the new and better tracking of educational system in B&H. The project started in 2010 under the name Smart School.

3.SMART SCHOOL

Smart school is a set of applications that manage all school resources, providing access to school employees such as teacher to populate data about a student, and on the opposite side provides feedback to students and parents. On top of those groups of users, additional decision making users are involved as well. Smart School provides detailed reports about school wide data to school principals, and executive boards. The implementation of Smart School in schools in different cantons of B&H, allows this project to be compatible and satisfy each canton's possible specific need. Smart School closely follows to cover and give access to each parent and student. Following this guideline, parents and students can receive feedback from Smart School with different mechanisms, including access by internet and mobile phones.

3.1.Smart School Architecture

Smart school is built as three-tier architecture, being composed of a data, application and presentation tier. In order to cope with the scalability, performance and efficiency, each of those reside on separate hardware with high speed interconnection in between.

The bottom layer which represents the data tier is where the databases reside. The data tier acts independently from the above tiers. Smart School uses MySQL for the databases. MySQL is the world's most popular open source database software, used by hundred thousands of companies all around the world(MySQL). This database software covers the current needs for Smart School.

The next tier is the application tier, which covers all of the business logic in Smart School. The application tier communicates with the database in the data tier. The application tier exposes different methods for the above tier through web services. This tier always authenticates each remote request and if accessed by an authorized user, presents the transformed data from the data to the presentation tier. This tier handles request from different presentation applications, and offers different type of data representation. Depending on the type of request the web services can return the data in either Extensible

Markup Language XML or JavaScript Object Notation JSON. The traditional XML allows the representation of data to be both human and machine readable, but often contains repeated tags that describe data. XML is acceptable when exchanging data between high speed connections, but has downsides when it comes to transfer between slow connections, as the case when using mobile internet over mobile providers. In this kind of transfer it is very important to transfer the data as lightweight as possible. In order to cope with this kind of speed and bandwidth issues, JSON is used to return data in Smart School. JSON is very similar to an array or vector in major programming language. It is language independent and many languages include default implementation to read and parse this format of data. In Smart School, JSON is primarily used for data exchange between the mobile apps and this tier.

Smart School has several implementation of the presentation tier. This tier first authenticates with the application tier, and then communicates with different requests and replies. The following components make up the presentation tier: Administration Web and Parent/Student Web. The administration web component is a web application that represents the user interface for the entire Smart School. This component allows the authorized users to manage the entire system from a web app. The application exchanged the information with the web services. As the school users have different privileges and overview of the system from the one of parents and students, two separate components have been created. The Parent/Student component has only modules that are directly related to a single student overview. This separation is primarily for security reason and potential bugs in the system, but as well to offer a simplified overview of modules just for parents and students.

3.2.Smart School Feedback Modules

In order to cover the targeted user groups of Smart School, the following main feedback modules have been introduced:

Student performance/tracking Module

Reporting Module

Parent/Student Module

3.2.1.Student performance/tracking module

This module is used by the user groups that are consisted of subject teachers. The teachers are assigned to subject from the administrative module, and can only manage students enrolled in the teacher's subjects. From this module the teacher can send and receive messages from parent and students. The teacher can easily and quickly get and overview of the subject average, and get details about the students above and beyond the given thresholds in average. All information from this module can be exported as spreadsheet and managed in locally on

computer from any spreadsheet tools such as Microsoft Excel or LibreOffice Calc. If a teacher is assigned the role of a class teacher (class manager), additional functionalities are available. Those functionalities enable the class teacher to manage task such as getting collective reports about an entire class, preparing data for parent meeting and scheduling parents meetings by sending bulk emails and short messages to parent mobile phones. Additionally the class teacher is responsible for the behavior tracking of each student in the assigned class.

3.2.2.Reporting Module

In order to get overall feedbacks from any application, a reporting module is necessary. The reporting module in Smart School is a collection of predefined reports that given detailed insights about data in the system. The reporting module is used by different groups of users, with the ability to access different types and levels of reports. Apart the predefined reports, a dynamic form allows to create reports on the fly with custom joined data. At the first level, users with teacher privileges can query reports with data about their teaching subjects, and enrolled students. The next level allows the school principals to get school wide report. In those reports the school principal has detailed overview of all teachers, subjects and students. The reports are always collecting direct data from the databases, so they always show the accurate image of the data.

In order to provide a higher level of reports over multiple schools, additional two more levels were added. Bosna Sema, which has several schools in several cantons use those levels, one for the head of departments, and one for the executive boards.

For the purpose of making decision on the top level, the executive board has to have detailed insight reports for any board meeting. For this purpose, a higher level in the reporting module has been introduced. This level has access to all schools combined, offering information from a single students, and teacher to the entire school performance. This allows the executive board to have accurate and up to date information, upon which they can make crucial decisions.

The Cantonal Ministries of Education in B&H could benefit from this level of reporting. Although each school is sending collective data about schools to the Offices of Statistics in B&H, the information on the official Canton web sites are more than outdated. An example can be given for the Canton of Tuzla, where the information about high schools is presented from 01.12.2003, which is outdated for 9 years(Vlada TK, 2003). A similar case is with the ZE-DO Canton, where on the 1st October 2010, a detailed document about the high schools in canton has been presented on the official web site of canton from May 2006(ZE-DO Canton, 2010). Smart School can allow the cantons to have these varieties of reports instantly on any given date. Only with accurate and up to date reports can suitable decisions be made.

3.2.3. Parents/Student Module

Smart School provides an in-depth feedback to parents and students. During the initial design many aspects have been taken into consideration about the traditional way on how the parents and students get the performance information from their schools.

Following these practices one of the initial requirements has been to provide first a quick and easy access to information for the preparation of a parent meeting. Smart School here allows the class teacher to collect instantly up to date data for a meeting. Also the class teacher can schedule a meeting through the application and send instant SMS and emails to parents with time and place of the meeting.

In order to provide constant access to parents about the performance of their child additional methods have been introduced. One method involved a web application access for parents over the internet, and the second one allows the parent to get information on mobile phone via short messages.

4. Security in Smart School

Smart School uses the latest technologies in order to provide secure access to sensitive data. The database contains privileged information about all students' achievements as well as personal information about the employees from the institutions who utilize Smart School.

To achieve a maximum level of security, all communication is exchanged through secure channels over Secure Sockets LayerSSL. Each time a user accesses the web application, a secure connection is established from the client browser to the server, meaning all information passed from the client to the server is encrypted and cannot be seen anywhere in between those two.

Continuing with our security layer, with the exchange of data through SSL all communication from the client to the server is secured, but we still have one more possible point which can be vulnerable, and through which unauthorized access can be gained. By design Smart School as a web application can be accessed from any place in the world through any Internet Service Provider ISP. This is primary allowed for the purpose that teachers and professors are not limited with the location from where they can access data. Following this design it is possible, with the use of a username and password to access the web application anytime from anywhere. In case a malicious user gets the real user access details, the malicious user could logon to the web application and perform some unauthorized actions in the application.

There are many possible scenarios on getting access details from an authorized user; one includes the fact that many users use similar username and password with multiple services on the internet, such as for email address, social platforms, bulletin boards, forums, chats, online shopping cards and many other. If one of those services gets compromised, the malicious user could try the same password for some other services, and then possibly get access to our application.

Another possible security scenario is that the client computer is infected with a Trojan virus, or some other malicious application such as key logger, which would send access details to a malicious user, where again a possible treat against the system could be used.

In order to prevent unauthorized access even when knowing the username and password, Smart School implements an additional layer of security by introducing two-factor authentication. Two-factor authentication requires the user to authenticate with more than just a username and password. There are many variations of the multifactor authentication that includes even more than two factors.

Smart School uses a two-factor authentication system. The first factor in the authentication is the well-known username and private password by the user and the second factor is the process of generating an additional verification code called One Time Password OTP, which is generated by a security token. Upon each logging the security token will generate an OTP which will be valid just for once. The security token is based on the Time-based One-time Password Algorithm TOTP, where each token based on its internal serial number on the given time generates a number(TOTP: Time-Based One-Time Password Algorithm). At the time of the logging process the server performs the same algorithm and then compares the entered OTP with the one generated on the server side. The server has a match table between each token and user, so the server 'knows' on which serial to perform the algorithm. This security layer prevents possible unauthorized access to the web application, even if the user gets access to the username and password of the account. This method of authentication is widely used by banks for online banking.OTP is becoming more popular among everyday used web services. Google has introduced the so called 2-step verification process for accessing any Google protected resource(Google, 2012). Similarly Amazon implemented AWS multi-factor authentication when accessing the Amazon Web Service infrastructure(AWS, 2012).

5.CONCLUSION

Although the majorities of components have been developed and are already in use, Smart School still undergoes under changes and copes to adapt with the new functionalities. All users of the system including the parents and students are constantly providing feedback which guides to a more quality application. The main goal behind this project was to offer a unique application that will cover and satisfy all of the user's requests, following the educational legislations in B&H. This goal has been met.

Currently the project is only implemented in Bosnia and Herzegovina educational institutions, however future plans include offering this application to all primary and secondary schools in B&H. The future expansion also includes the development of rising mobile applications for two major smartphone mobile platforms used in B&H that consist of iOS and Android.

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