

A Survey on Cross Platform Application for Education System

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Abstract—Nowadays there is tremendous increase in users with smartphones. Mobile devices provide “information at anytime and anywhere”, this offers a better experience to the users in accessing the information and applications. The applications developed are according to the operating systems of respective mobile. As a result we need to develop different applications for every mobile operating system. Thus we came up with the idea of development of cross platform application that helps to build an application only once which could be deployed over various platforms. Thus, a survey was carried out to identify various cross platform approaches to build an application for academic purpose. In addition to this, various Data Visualization tools and Voice Agent API's were surveyed for the design and develop of the cross platform application.

IndexTerms—Cross platform application, Android, iOS, Smartphone, Visual Analytics, Voice Agent.

I. INTRODUCTION

An integrated academic management system is needed for any educational institution to manage the academic processes. In the recent years there is an increase in the number of users using Smart phones - Android based, iPhones and tablets. So there is a need to develop a mobile application which could be capable of handling the required functionalities. Thus, our idea is to develop such an application with additional functionalities such as graphical representation of the data and audio form of the data (voice output).

Developing mobile applications is a challenging task because Smart phones do not rely on a single standardised platform. The Smart phones will have different operating systems - Android, iOS, BlackBerry, Windows Phone - all of them being significantly different. These challenges could be overcome by using cross platform development approaches. Different Cross platform development approaches were compared on different criteria as shown in Table I. Finally, the IBM Mobile First Development Studio was found to be the best framework and it was explored more [1].

Data Visualization techniques could be employed for the effective representation of the data. A comparative study of the data is done thus leading to efficient understanding of the same. Hence, a number of data visualization tools were explored. Among all the existing Business Intelligence (BI) tools as shown in Table II, we found that QlikView is more useful to our project.

Further the data could be represented in the audio form to help visually impaired and illiterate people to clearly understand the information. Different text to speech APIs were explored as shown in Table III, AT&T provides Speech APIs which could be used easily with IBM Mobile First Development Studio. To clearly understand the working of API the architecture of Text to Speech synthesizer was surveyed [2].

II. CROSS PLATFORM DEVELOPMENT APPROACHES

ASmartphone provides more computing capability and connectivity when compared to that of normal phones. Their efficiency is more when compared to that of normal phones with respect to features like Storage capacity, battery and operating system. People use the mobile applications more than the calls as per their requirements. There are various operating systems and each have their own specializations. There are various types of mobile applications –applications based on web technologies, native applications and hybrid applications [3]. Mobile applications development poses a number of challenges like a variety of operating system, SDKs, excellence in user experience, easy updation, cost of development and time required to market the application. Developing application for specific platform requires in depth knowledge about the respective Operating systems and their corresponding SDKs [4][5][6]. So most of the developers like to consider development of cross platform applications [7]. Cross platform development approaches helps the users to implement their application in a single step for a range of platforms avoiding repetition and increasing productivity [8]. The architecture of the Cross Platform is as shown in Fig 1.

Requirements of cross platform framework include:

- Support multiple OS like Android and iOS.
- Capable of providing rich user interface as good as native application.
- Easy back end connectivity.
- Ability to develop highly secure application.
- Ability to access device specific features like camera, sensors and geo-localization.

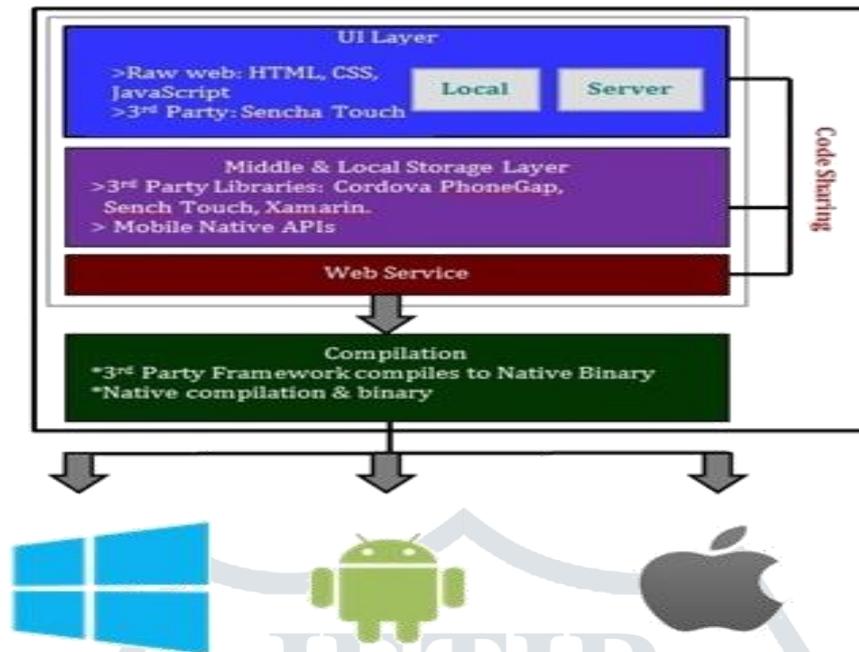


Fig. 1 Cross Platform Architecture

Several Cross Platform development approaches include IBM MobileFirst Development Studio (formerly Work light Studio), Appcelerator Titanium, Adobe Phone Gap, Xamarin Studio. These approaches were compared based on several infrastructure and development perspective [1], as shown in Table 1 and we found that IBM Mobile First Development Studio best suits our requirements.

TABLE I
COMPARATIVE STUDY OF CROSS PLATFORM APPLICATION

	IBM MobileFirst	Adobe Phone Gap	Appcelerator Titanium	Xamarin Studio
Language Used	HTML5, JavaScript, CSS3	HTML5, JavaScript, CSS3	HTML5, JavaScript, CSS3	C#
Development IDE/Platform	Yes	No	Yes	Yes
Cross Platform Support	Yes	Yes	Yes	Yes
Application Server	Yes-Worklight Server	No	Yes Appcelerator Cloud Server	Yes- Xamarin Test Cloud
SMS/Push Notification	Yes	No	Yes	Yes
Open Source	Yes	Yes	Yes	Yes

III. IBM MOBILEFIRST DEVELOPMENT STUDIO

IBM MobileFirst Studio, an Eclipse-based integrated development environment (IDE) helps developers to conduct virtually all the coding and integration tasks required to develop rich and engaging applications [9]. The architecture of IBM MobileFirst Studio is as shown in Fig 2.

A. Features of IBM MobileFirst Development Studio

1) *Pure Native Development*: The pure native development approach allows us to create applications that fully use the device capabilities without any compromise on performance and user experience. Such applications are written for a specific platform environment such as Java for Android or C# for Microsoft Windows Phone 8, Objective - C for iOS and Microsoft Windows 8 Command Line Interface.

2) *Native Device SDK Integration*: MobileFirst Studio allows integration with the Software Development Kits (SDKs) of the mobile devices including Android, iOS, Microsoft Windows 8, Blackberry and Microsoft Windows Phone. This SDK integration supports developers to take full advantage of the native code capabilities, development tools, testing and debugging mechanisms that are native to the mobile SDKs.

3) *Hybrid Development*: Hybrid applications execute inside a native container and use the browser engine to display the HTML5/JavaScript and CSS part of the application interfaces and business logic. The native container, based on Apache Cordova also known as PhoneGap, grants application access to device capabilities that are not accessible to standard web applications, such

as the accelerometer, camera and device local storage. Hybrid applications developed with the MobileFirst Development Studio can be distributed through public or private cross-platform application stores.

4) *Rich Page Editor*: The MobileFirst Studio provides a WYSIWYG drag-and-drop for UI design and development. With these features, developers can create pure HTML or HTML and JavaScript files by dragging components from a built-in palette to the HTML canvas.

5) *Unified push notification and SMS*: The MobileFirst Platform provides a unified API to send push notifications and SMS from the server to mobile application. The MobileFirst Platform has the facility to send broadcast notification to all devices and targeted messages to a specific set of users, a specific device or a specific user.

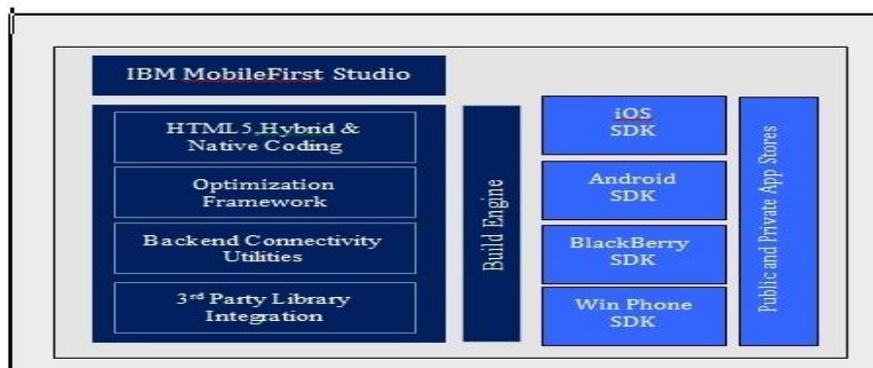


Fig. 2 IBM MobileFirst Studio

IV. DATA VISUALIZATION

Data visualization is the technique used for effective representation of the data. As the rate at which data is being generated is increasing tremendously, data visualization techniques are found to play a great role in effective understanding of the big data. Sangeeta et.al [10] discusses the idea of representing data in the form of charts and graphs. Huge amount of data present in database or Excel sheet is very complicated and it takes a lot of time to take decision. Data Visualization helps in graphical representation of the big data leading to easy and comparative understanding of the data. The best way to communicate with a non-technical user is through Data Visualization. The most important thing is that the information should reach each and every user in a very efficient and effective manner [11]. The best approach to do so is via Data Visualisation. The best way to extract data from an ever increasing flow of data is through Data Visualisation. It seems like an information map for the user.

The use of Data Visualization has grown rapidly in education systems for the following reasons:

- Increase in data quantity and improved data formats
- Advances in computing and increase in number of tools available for analytics.

The main goal of data visualization is efficient communication of information through graphical representation that helps in decision making [12].

A. Big Data

"Big data" is the term for a collection of data sets which is very complex such that it is very difficult to process the data using traditional data processing applications. It is difficult to assess accuracy, uncertainty and quality of the data. The challenge for Big Data applications is to explore the large amount of data and extract the useful information required for future actions as requested by the user [13].

The extraction of required and meaningful information from high dimensional data can be done using a number of automatic data analysis and visualization methods. Hence, there is a need for data visualisation tools which analyses the big data by generating charts and graphs that would help in comparative and easy understanding of the data [14].

Big data could be either structured (traditional DBMS tables) or unstructured like email attachments, PDF documents, academic records like certificate image, medical records such as x-rays, ECG and MRI images, graphics, audio, video, contacts etc [14].

Most of the enterprise business applications are concerned with managing unstructured data because about 80% of business data is unstructured. Big data analysis has a significant effect on business. It helps to identify the changes and respective solutions in the business data. It also helps to explore more business opportunities and possible changes in the market.

Nowadays, smartphones exceed the computational power of desktop computers, that supports in analysing large quantity of data and helps in producing data in the fields of sociology, geology etc [12].

B. Visualization Techniques

The visualization techniques can be broadly classified into interaction techniques and graphical representation of data. It refers to visual form in which data is represented like bar charts, line charts etc. Interaction techniques refer to how the user can interact with these graphical models and give the freedom and flexibility required to properly understand and explore the graphical models of data [15]. Visualisation based data tools focuses on front-end of data helping users to explore data more easily and understand it more fully. This helps in creation of graphical data on Smartphones [11].

All visual analytic systems can be divided into four categories:

- [1] Exploration allows generation and verification of hypothesis. This gives additional knowledge of data.
- [2] Dashboards are used to communicate the findings from graphical representation. Dashboard consists of fixed set of visualization controls allowing interactions through selection, filtering and drilling down [16].
- [3] Reporting helps in generating static summary of graphical models.
- [4] Alerting provides automatic notifications when data reaches predefined values.

The design and evaluation of data representation depends on user's ability to understand the data and operate on it individually. There exists uncertainty about the ability of current system to support decision making in correspondence with representation of data for the following reasons:

- The operations supported by many visualization systems is equivalent to simple database queries. According to recent studies users achieved only 68% - 75% accuracy on simple questions based on commercial systems, hence there is a need for improvement on these issues.
- The current visualization techniques are not agile, they support the formation of simple, static models from basic queries on historical data.
- The present visualization systems do not deal with the uncertainty of data [17].

The challenges need to be faced while choosing optimal Visualization library include [18]

- Support for Devices, Browsers and Platforms
- Visualization of the data that has to be plotted.
- Performance of the chart produced.

Keeping all these challenges a number of data visualization tools were compared based on the following criteria.

TABLE II
COMPARATIVE STUDY OF DATA VISUALIZATION TOOLS

	Spotfire	Qlikview	Tableu
Usability	Easy	Very Easy	Easy
Implementation speed	Good	Very high	Good
Pricing	Very high	Average	Very high
Data Integration	Good	Excellent	Good
Dashboard Support	Good	Excellent	Good
Memory Optimization	Average	Excellent	Good
GUI	Easy	Very Easy	Easy

With the comparison study shown in Table II, we come to a conclusion that Qlikview is the best tool for development of our Application.

C. Challenges faced by Visualization Tools

The various challenges faced by Data Visualization tools [14].

- [5] Semi and unstructured Data are difficult to represent in graphical form like charts and graphs.
- [6] Advanced Visualization (VA): It take a long time to integrate innovative or advanced visualization techniques.
- [7] Customizable Visualization: Gives users the freedom to change visual parameter setting.
- [8] Real Time Analysis is difficult in graphical representation of real time data that is generated at high speed.
- [9] Predictive Analysis: Only few VA systems support predictive analysis.

Currently, Visualization Techniques are being used to support learning. Visualization techniques mainly use to discuss meaning of information and it supports several activities which is as shown in Fig 3. Huge amount of Data/Information (input) is converted into Graphical design (output) [19].

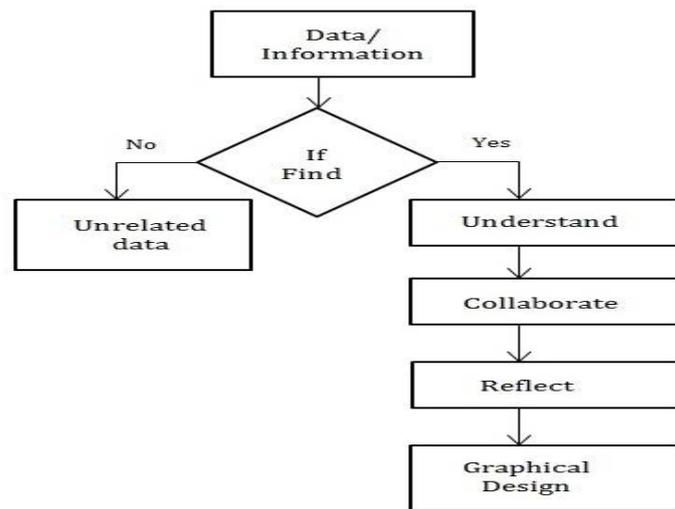


Fig.3 Data Visualization Flow

V QLIKVIEW

The Qlikview Business Discovery platform is user - driven Business Intelligence tool that helps people to make better decision based on data, people and place. Users can create and share knowledge and analyse in groups. Business people, Information workers, and technology decision makers search for the data that they need using these tools and make better decision for further work.

With Qlikview, users can explore information simply by clicking field values in list boxes and display the required data in charts, graphs, maps, dates in calendars, cycling over various charts and graphs, and many more. This fully interactive application contains a dashboard, a products view, a regional view and a customer view, etc. A QlikView application comprises much interactive visualization. All the visualizations are connected; when the user makes a selection in one, all other information compresses dynamically and gives a new view. Mainly QlikView is known as a pioneer in in-memory Business Intelligence [20]. QlikView offers efficient and effective communication and holds the data using In-Memory technology, accessible to multiple users.

A. The QlikView In-Memory Business Intelligent Technology

QlikView, from QlikTech Company, is the first in-memory business intelligence technology to be introduced into the market. It is the leader of in-memory analysis software. In-Memory BI consists of in-memory Database system [20]. Data in in-memory business intelligence is simply being held and analysed into main memory, i.e. Random Access Memory (RAM). In-memory BI approaches are offered by various vendors which consist of three main solutions – fast query engine, on-demand calculations, and visually interactive user interface. Fast query engine allows the IT and operational users to query data and present it immediately. It divides data into two types relevant and irrelevant based on the queries. At last, visually interactive user interface provides pre-built associative model for data interaction such as tables, graphs, charts, and dashboards. It contains only relevant data according to user's request, but not whole data [21].

Qlikview discovery platform holds the data in memory for many users and maintains associations in the data by default, calculates aggregations on the fly, compresses in-memory data to as little as 10% of its original size. It has advanced memory optimization and data compression functionalities. It has strong drill down capability and fast response time and loading time because of its In-memory architecture [20].

B. QlikView Architectural Overview

QlikView consists of 3 major components – QlikView Server, QlikView Publisher and QlikView Desktop, each of them role an important part in the design, development and implementing almost all QlikView deployment [20][21].

1) *QlikView Desktop*: The QlikView Desktop is a tool that is used by business analysts and developers to create a data model and to layout the graphical user interface. The developers will use a SQL-like scripting environment to create the linkages (connection strings) to the source data and to convert the data (e.g. renaming fields) so that it can be analysed and used within the UI. The QlikView Desktop is an environment where all user interface design and user experience is developed in a drag-and-drop pattern. The file type created using the QlikView Desktop is known as a QVW (.qvw, or QlikView file).

2) *QlikView Server (QVS)*: The QVS is a server-side product that contains the in-memory analytics engine and which handles all client/server communication between a QlikView client and the server. It includes a QlikView Management Console for providing administrator access to control all aspects of the server deployments (security, distribution, clustering etc.) and also includes a web server to provide front-end access to the documents within.

3) *QlikView Publisher*: The QlikView Publisher is a server-side product that performs two main functions:

- It is used to load data directly from data sources defined via connection strings in the source QVW files.
- It is also used as a distribution service to reduce data and applications from source QVW files based on various rules and to distribute these newly-created documents to the appropriate QlikView Servers or as static PDF reports through email. Data

sources that can be easily accessed by QlikView include standard ODBC or OLEDB compatible databases, standard files such as Microsoft Excel, XML etc.

C. Advantages of QlikView

Various advantages of using QlikView are [22]:

1) *Works the way people's minds work*: QlikView discovery is flexible. It is not limited to pre-defined drill paths, users can ask and also answer for streams of questions on their own groups and teams using QlikView's collaborative capabilities.

2) *Differentiate the data based on user requirements*: With QlikView, users can see the relationship among the data. They can see associated and not associated data based on their selections..

3) *Provides direct and indirect searching*: With QlikView search provides users to search for the relevant words or phrases in any order and get their respective results. A global search bar helps users to search across the entire data set [20].

VI.VOICE GENERATION

Voice Agent generates audio that speaks a piece of text. Text to Speech (TTS) is majorly meant for disabled set of humans, who are not in a position to use text information for communication. So the TTS converter will be highly useful for these visually impaired and illiterate people to hear and understand the information. This also resolves the problems arising due to differences in script system [23].

Though many smart messengers are available, they help users to send messages but not receive them. Users can save the messages and send it across as SMS, but there won't be any interaction. Also many of these applications are not available in multiple language platforms [24].

The main objective of TTS is to convert the given text to corresponding voice output. The input to a TTS system is not a phonemic sequence and is a raw text as available in websites, blogs and documents. Deploying a speech system on different platforms such as web, phone and smartphones require significant customization. Web based application like chrome voice search and smartphone based application like Siri, Android voice search etc. use Push-to-talk interface to initiate input. It would be more helpful to develop a similar application that is portable to different platforms (Smartphones) [24]. The methodology of TTS includes using the acoustic representations of the speech along with the linguistic analyses of the text to obtain the correct pronunciation [2].

A. Architecture of TTS

The following Fig 4 shows the architecture of TTS.

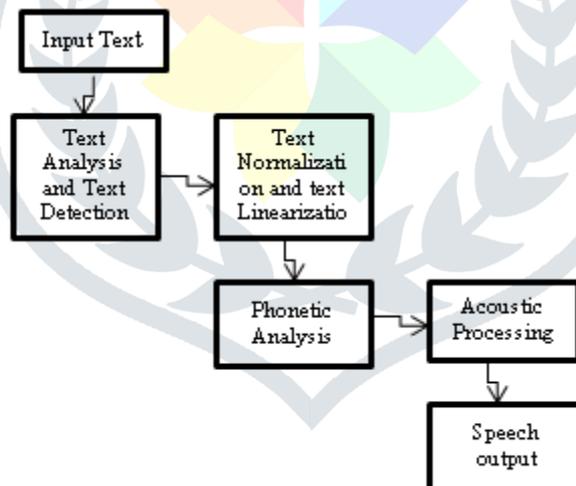


Fig. 4 Architecture of TTS

1) *Text Analysis and Text detection*: A pre-processor which analyses the input text and organises it into a meaningful list of words.

2) *Text Normalization and Text Linearization*: Text Normalization is transformation of text into pronounceable form.

3) *Phonetic Analysis*: It converts the orthographical symbols into phonological ones using a phonetic alphabet.

4) *Acoustic Processing*: There are 3 types of acoustic processing

- Concatenated Synthesis
- Formant Synthesis
- Articulatory Synthesis [23].

B. Automatic Speech Recognition

Many of the Text-To-Speech techniques are borrowed from Automatic Speech Recognition. ASR System is used in telephony and embedded system applications. Machine Translation (MT) is a branch of computational linguistics that investigates use of software to translate text to speech [25]. It is especially useful for tasks such as understanding and speaking with people who are visually impaired. This task is quite complicated as a large amount of human knowledge is to be encoded in machine processable form.

The ASR component processes the voice in its original language creating a text version of it. This text version in original language goes to the Machine Translation which translates to target language [26].

C. Speech APIs

Through the literature survey, we have come across different Speech generation APIs as shown in Table 3.

TABLE III
COMPARATIVE STUDY OF SPEECH APIs

Technologies	Microsoft Speech API	Java Speech API	AT&T Speech API
Types	Windows Computer API	Java Specification API	Android Application Development API
Vocabulary Size	Large	NA	Large
Common Usage	Desktop Application Development	NA	Application Development
Recognition Quality	High	Depends on Implementation	High
Data Support Language	Few	None	Many
New Language allowed	No	No	Yes
Open Source	No	Yes	Yes

From the above study, we come to a conclusion that AT&T API would be a better technology for development of our Application.

VII. CONCLUSIONS

In this paper, we surveyed various Cross Platform Approaches for development of the application. In addition to this, different Data Visualization tools and Speech API's were surveyed. Depending on the requirements, the survey made on various cross-platform tools indicated that IBM MobileFirst Development Studio would be a better tool.

Thus, based on the survey we conclude that QlikView (Data Visualization tool) and AT&T API (TTS) best suits our application.

Hence, our proposed application includes features like-Login Credentials for students and faculty members, Course Registration, Attendance Notifications and managing academic details of the students.

The future plans include development and integration of Placement functionalities, Library Management System. The Voice agent would be made secure so that confidentiality is maintained across multiple platforms.

VIII. ACKNOWLEDGMENT

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