

A Web-Based Approach for Designing and Deploying Flexible Learning Tools

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Abstract. This paper presents the current work in the development of a web-based approach to offer an authoring-tool for the creation of mobile applications with data collection purposes. The web-based solution additionally offers the possibility to visualize previously collected data in the web-browser. An idea of a mobile web application is presented that uses a diversity of sensors of a mobile device for collecting environmental data in the field. This paper describes how to integrate such an approach in the context of the LETS GO [1] research project. It also identifies and addresses current issues in end-user programming and mobile cross-platform development.

Keywords: Web-based framework, Cross-platform development, End-user programming, Authoring Tool.

1 Introduction

The rapid evolution of web and mobile technologies brings new opportunities to developers and researchers in the process of creating novel mobile applications. Positioning technologies, high definition cameras and other sensors, as well as continuous Internet access became standard features of modern mobile devices. This leads to continuous growth of the market of mobile applications that take include the functionalities of various sensors, so called mobile mashup applications.

In spite of the multiple benefits that these technologies offer, a major challenge for developers of mobile device applications arise due the huge fragmentation of the market. The wide spread use of different devices and mobile operating systems is an issue that mobile developers need to address. One example is lack of a standardized way to access features and resources of mobile devices, e.g. sensors differs from every operating system. This difference can be even found among different versions of a same mobile operating systems and mobile devices. Furthermore, programing languages used to access mobile sensors differ between

different mobile device platforms and models, forcing developers to spread their efforts between multiple languages in order to cover a high percentage of mobile devices in the market.

The emerging web technologies, including HTML5 and new JavaScript approaches, provide some of the requirements that can be used to address some of the challenges mentioned above [2].

Moreover, with the growing importance of web technologies in the area of mobile applications, it becomes crucial to give the end-user the possibility to create and deploy his own mobile application. A good example for this issue is the educational field. Mobile devices and applications can be effectively used in schools for supporting field trips to enhance the learning experience [3]. But one cannot assume that every person, specially teachers, that wants to create an application for mobile devices will have the technical and programming skills to compose scenarios and applications suiting his/her requirements. Thus, one area of concern developers and researchers are exploring, is how to give end-users the possibility to create his/her own mobile applications. A promising concept is to provide an authoring tool to design scenarios.

This leads to the main question that will guide this work is formulated as follows: How web technologies could facilitate a framework to support end-user programing to design and deploy flexible mobile learning applications across diverse devices and platforms?

2 Motivation and Related Work

Existing projects within the educational field but also in a variety of other fields, address the problem of end-user programming and also for mobile and cross-platform applications. For instance [4–7] discuss promising approaches for end-user programming and also mobile mashup development. Providing an authoring tool to enable end-users to design his/her own mobile application is the common approach. However, in the landscape of authoring tools for mobile learning applications, it is not an easy task to find projects like [4] that are addressing a cross-platform solution. The LEMONADE project [6] presents an interesting approach to introduce a way to visualize the data that is collected during the execution of a mobile application. Another interesting approach in the mobile learning domain with support of web-based applications its the nQuire project [8], but it lacks an authoring tool.

The previous projects present an initial overview of the possibilities to support the flow of mobile learning applications from designing to visualizing. However, there seems to be a need for cross platform solution to support the flow of designing mobile learning also concerning the visualization. As a result, I present a web-based approach that targets to close the gap described above. Recent developments in HTML5 and JavaScript allow to not only easily developing desktop web applications but also mobile web applications without much restrictions. HTML5 nowadays even offers access to internal resources from recent mobile devices, such as *iOS5* and *Android 4*.

Another benefit that comes with a web-based approach is the usage of Web services/APIs like GoogleMaps that can be integrated in mobile applications to generate mobile mashup applications. Those web services/API like Google Maps or Amazon Web Services usually providing a JavaScript interface. Therefore, a mobile web application based on HTML5 and JavaScript offers a good developing platform to these web services/APIs. HTML5 applications run on every device with a browser on it, so a developer doesn't need to take a certain OS in account to develop and deploy his application. With developing HTML5 applications also handle the requirements for different screen sizes and resolutions. This is why, the presented approach relies on HTML5, CSS3 and JavaScript for a cross-platform solution.

The ultimate goal of these efforts is the development of a web-based framework to allow end-users to design mobile learning activities and applications, make them automatically available on mobile devices, and offers visualization of the collected data either in a mobile or desktop browser. Furthermore, the mobile application is not limited to any device but runs on every device with a browser installed. Such a framework should be able to support the following aspects:

- **End-user programming.** An authoring tool for end-users to design his/her own mobile applications.
- **Mobile mashup application.** The mobile application can combine different web services or APIs to increase the opportunities how the application can be used.
- **Visualization.** The framework offers a tool that provides the visualization of the data that is generated by the mobile application, such as sensor data or user input.
- **Cross platform development.** All components of the framework are platform independent. This includes the authoring tool, the mobile application as well as the visualization tool.

3 An Authoring Tool to Create Forms for a Mobile Data Collection Application

The LETS GO (Learning Ecology with Technologies from Science for Global Outcomes) project [1] serves as a foundation of this initial approach to develop a web-based framework. The goal of the project, is to design challenging collaborative learning data collection activities by utilizing mobile and sensor technologies. However, in the current state the approach is lacking the possibility for end-users to design mobile applications for data collection activities, so the developer has to do the design with the requirements of the end-user. The data collection tasks within LETS GO are provided as XForm¹. This XForm provides the data that is used for the mobile client to generate the mobile application. To access the XForm from the mobile client, a service provided by ODK (Open

¹ <http://www.w3.org/MarkUp/Forms/>

Data Kit)² is used. As of now, the XForm has to be created by a developer and end-users are not given any possibility to design their own XForms.

The first step towards the goal to support end-user programming is to introduce a prototype of an authoring tool for the LETS GO project. The mobile application of LETS GO consists of different input forms where it is possible to enter data that is collected either from observation or sensors. Therefore the authoring tool enables end-users to define certain input forms, e.g. sensor data, taking pictures and more as a web-based application. The end-user can add new screens and add forms into these screens. Afterwards, it is possible to define a sequence of appearance for the input forms created before. This is made possible by the canvas and drag and drop feature that HTML5 offers. Each screen has an anchor and the anchors can be connected. The created input forms are send as an XForm to the ODK service and therefore available as an application for the mobile client.

4 Outlook

As a next step, the development of a web-based mobile application is scheduled. This enables not only the design of mobile learning tasks in a web-based manner but also the execution of these tasks. As of now, the input forms for the mobile application are saved as XForm. To be able to take full advantage of HTML5 combined with JavaScript, the forms will be stored as JSON objects. The last step to complete the support from designing to visualization is to develop a web-based visualization application.

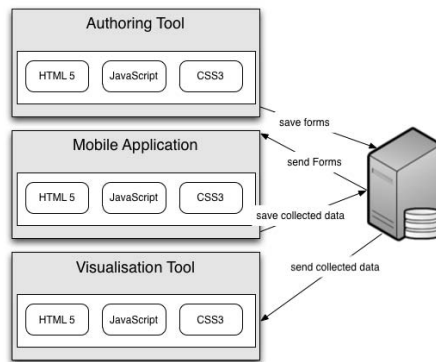


Fig. 1. Framework Architecture

The goal is to have three components, an authoring tool, a mobile application and a visualization application forming a framework. This framework enables an end-user to design the flow of a mobile application and store it. The mobile application loads the stored flow and is able to execute it. Actions that are performed with the mobile client are also stored, so it is possible to visualize

² <http://opendatakit.org/>

the data. Figure 1 shows the architecture of the framework. As described in the previous sections, the first step of this research is a prototype of an authoring tool to be integrated with the LETS GO project. To get more requirements detailed surveys and workshops with teachers is planned. In the future, this tool will be extended so it will not be limited to support just the LETS GO project but applications for a variety of use cases. As mentioned before, the forms will be transferred as JSON objects. In the same way the collected data will be transferred. Since the MongoDB³ database stores data in as JSON-style documents, it will be used as a persistence technology. As a server technology, NodeJS⁴ will be used.

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³ <http://www.mongodb.org/>

⁴ <http://nodejs.org/>