UB Online Courses: An On-Demand Video-Streaming Service for Online Education

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Abstract

Online education in the past few years has become a very convenient and cost-effective alternative to the traditional class-based education offered on college and university campuses. Its popularity can been seen in the increasing number of online courses being offered by many universities around the world; and the University of Bridgeport is no exception.

To handle the increasing demand on online education programs, the current methods and technologies need to be improved to meet the student expectations of ease of use, accessibility and availability. In this work we're addressing issues in the current online education services provided at UB, such as the standardization of video formats, making the lecture videos viewable on smart phone devices, and making all courses available in a central location.

Introduction

At UB, we noticed that each online course is being offered through a different web service or site, depending on what's available to the lecturer. Some courses are being hosted on local servers on campus, while others are uploaded to a public-domain service like Youtube, and there's no agreed-upon video format or quality standard. There are several issues here; the courses cannot be found in a single location, which is inconvenient to the students. Uploading to a public service instead of a local server can be a hassle to the graduate assistants since uploading large video files through the internet can be slow hindering the timely availability of the videos, besides there's no good way to control the user access on public services like Youtube, making video lectures viewable by non-registered viewers. Add to that the fact that videos are being encoded in non-standard formats that require browser plug-ins to play them, and in some cases they cannot be streamed at all and must be downloaded first. YouTube still uses the Flash video format (as of this writing), and iOS devices (i.e. iPhone and iPad) don't support that.

The objective of our work is to address the above problems by implementing a prototype for a video-streaming service for online courses hosted locally on campus that provides a centralized location for all courses and controlled completely by UB professors, graduate assistants, and admins. The videos will be encoded in standard HTML5 video playable by all modern browsers including those on smart phone devices and tablets.

Main Use Cases

The objective of UB Online Courses is to provide users with password-protected accounts that they need to log into in order to access the online courses being offered. The admins can manage the user accounts and the courses offered, and upload new video lectures for those courses as they become available.

Design, Architecture, & Implementation

Since its inception, UB Online Courses was designed as a RESTful web service implemented completely using open source technologies, with an API consumable by any client, and with a single-page web client as the user front end.

Single-Page Web Client (AngularJS)   Web   RESTful Web Service (Node.js/Express.js)   Non-Relational Database (MongoDB)
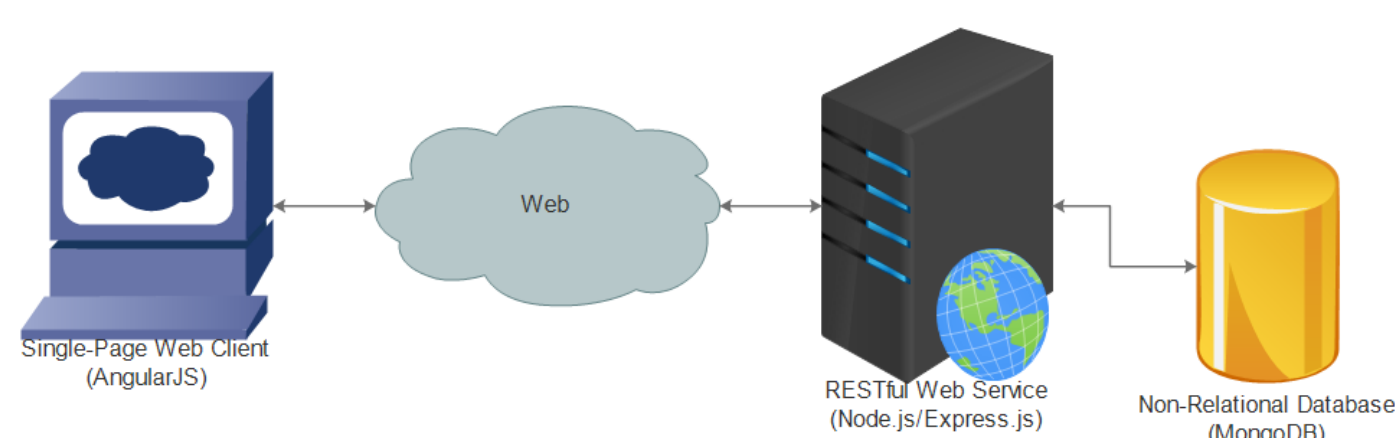
After researching the existing technologies we opted to use the following in our implementation:

- Node.js: A platform that runs JavaScript server applications on the server side.
- Express.js: A web application framework that runs on top of Node.js
- MongoDB: A highly-scalable non-relational database that stores records as documents in a binary JSON format (called BSON) and retrieves them as JavaScript objects. Queries are written as Javacript methods.
- AngularJS: An Mode-View-Controller web framework used to build single-page web apps.

This set of technologies comprise a web application stack commonly known as the MEAN stack. The main advantage of this stack is that it allows rapid development of web applications using a single language, JavaScript. It's the only stack in the market that uses the same programming language end-to-end.

Node.js and Express.js are used to implement the RESTful service that provides the user information, authentication & authorization, course information and video streaming. MongoDB is where all the information and video files are stored. AngularJS is used to implement the user-friendly front end as a single-page web app that communicates with the web service in the background and updates parts of the page without refreshing it completely.
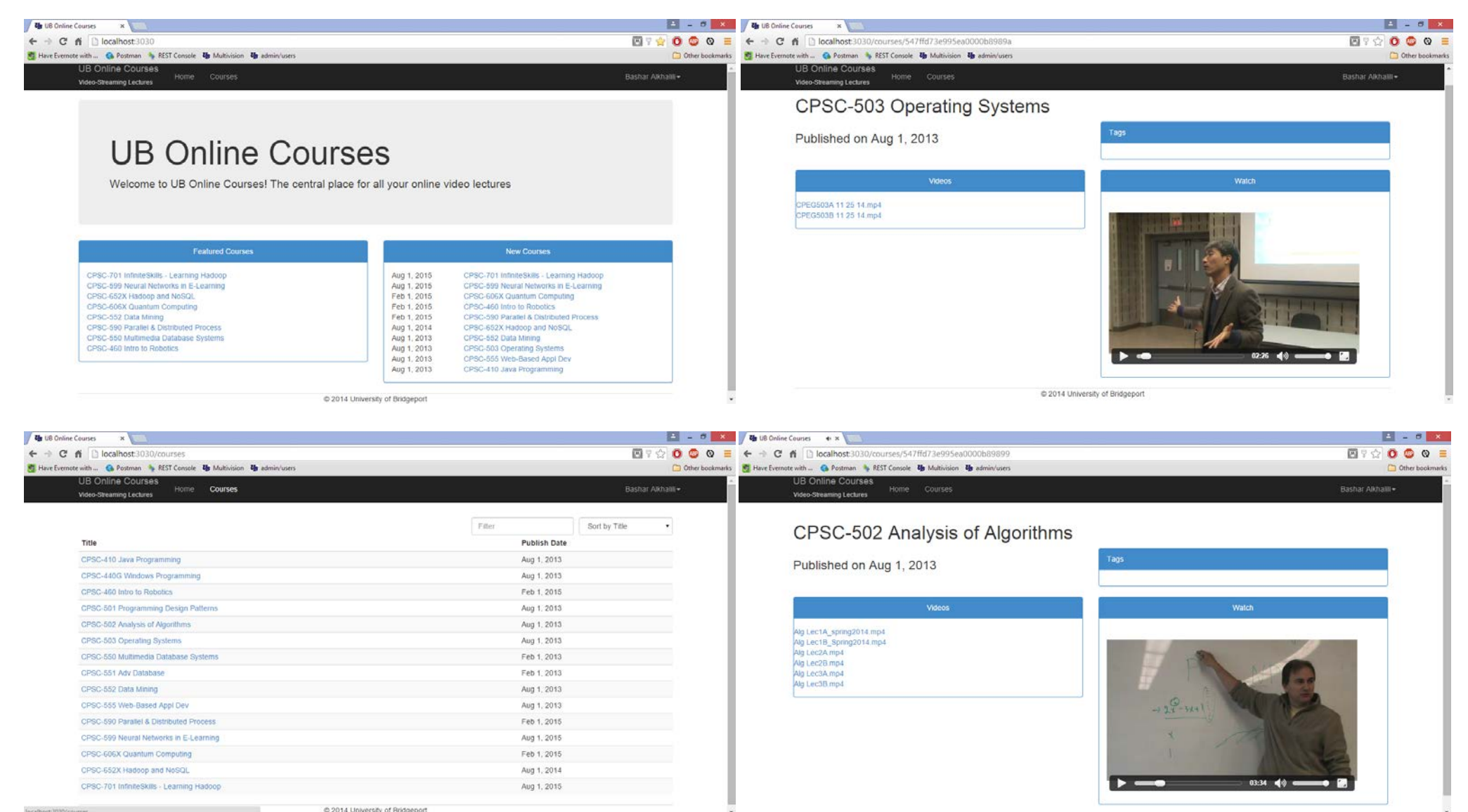
Future Work

Our work can be improved upon by taking advantage of MongoDB's capability of running MapReduce jobs to transcode videos to the appropriate formats as they're uploaded into the system. Currently the admins are expected to handle the transcoding outside of the system.

Conclusion

Through this work we showed that there's room for improvement on the existing online education services. Although our implementation is small-scale, the design and architecture introduced here along with the implementation can be considered the basis of an overhauled online education service that is built from the ground-up with cutting-edge open source technologies and complies with the latest web standards and best-practices, particularly HTML5 video, RESTful web service APIs, single-page web apps, and highly scalable non-relational databases.

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