

Can You Read What I'm Saying?

Closed Captions added to Molly Open Source Online Lecture System

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Abstract - *In offering online educational video lectures it is essential to provide captions for accessibility by Deaf/Hard of Hearing students. The Rochester Institute of Technology (RIT), being unique as the home of the National Technical Institute for the Deaf (NTID), has a significant percentage of Deaf/Hard of Hearing students and faculty. As such, we understand the need to support this population in everything we do. The tools described here, a recent addition to the Molly Online Lecture system, makes the addition of such captions an easy, WYSIWYG experience for video lecture authors. The system is entirely web-based and uses the W3C standard for closed captions via the HTML5 video tag.*

Keywords: Online Lecture, Online Learning, Closed Captions, Accessibility, Molly, Distance Learning

1 Introduction

The Rochester Institute of Technology (RIT) is unique in many ways, among them being the home of the National Technical Institute for the Deaf (NTID). Because RIT is the home of NTID we have a significantly higher percentage of Deaf and hard of hearing students and faculty than most other universities. As such, we need to address the needs of this population in everything we do. All videos used in teaching at RIT are required to be captioned. In the past, videos used in the Molly Online Lecture System (aka 'MollyPoint') have been open captioned, with the captions embedded directly in the video. There are several issues with this approach, including the difficulty of the captioning process for faculty, the inability of hearing students to turn the captions off, and the need to recreate the videos to correct even minor errors in the captions.

With the introduction of the W3C standard for closed captions and its adoption by the major browser manufacturers, it was decided to add dynamically generated

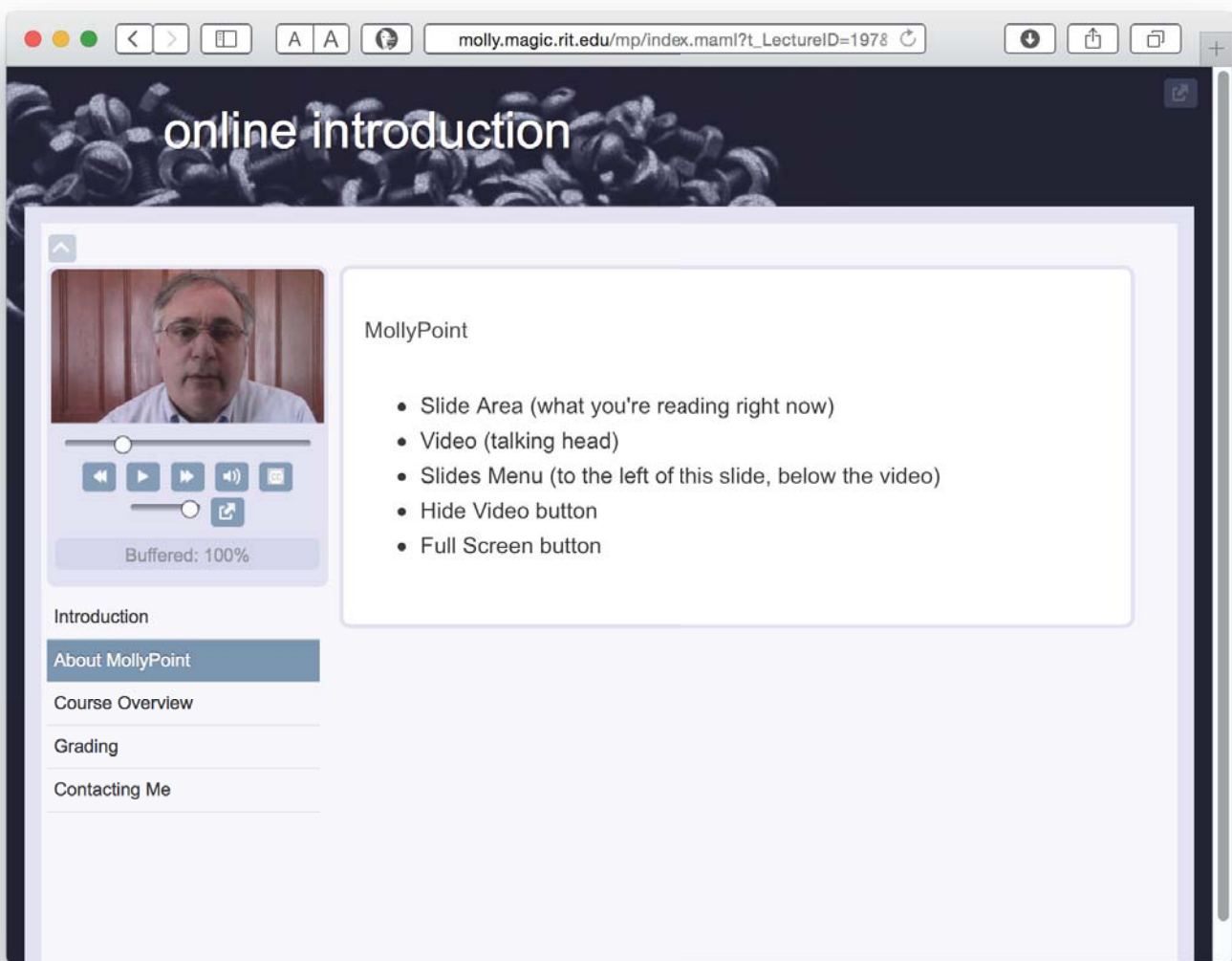
closed captions and an authoring tool for those captions to the Molly online lecture system.

The MollyPoint system has two key components: a presentation interface and an authoring/management interface. The presentation interface is designed for the viewing audience (students), while the authoring/management interface is for faculty to create their lecture slides and captions.

2 System Overview

The Molly online lecture system's design attempts to capture and simulate to a certain extent an in-class environment with face-to-face communication. Professors record video lectures and combine them in MollyPoint with slides that are linked to their time-coded place in the lecture. Slides are created by the faculty in a WYSIWYG editing environment with access to the underlying HTML code. Slide order can be easily changed via drag and drop of slide thumbnails. When a video is uploaded for the lecture, a timeline is automatically created and the author can play the video and drag the slides to the appropriate spot marked by a play-head icon on the timeline as the video plays.

In the presentation mode, the student plays the video and the appropriate slides are displayed as the lecture progresses. Additionally, the presentation is interactive. A menu of all of the slides in the lecture are listed below the video, with the current slide highlighted. If the student clicks on any of the slides, that slide is displayed and the video queues up or continues playing (depending on whether it was paused or playing at the time) from that point in the lecture. Likewise, the video has a normal progress slider and moving that slider to change the video's play position automatically displays the appropriate slide.



3 Application Architecture

The system was developed using a basic three-tier architecture, providing benefits such as reusability, flexibility, maintainability, and scalability.

3.1 Presentation Layer

The Graphical User Interface uses current web client-side technology: HTML5, CSS3, JavaScript and AJAX. The system is designed to be compatible with the most common current browsers: Chrome, Safari, Firefox, IE, and Edge.

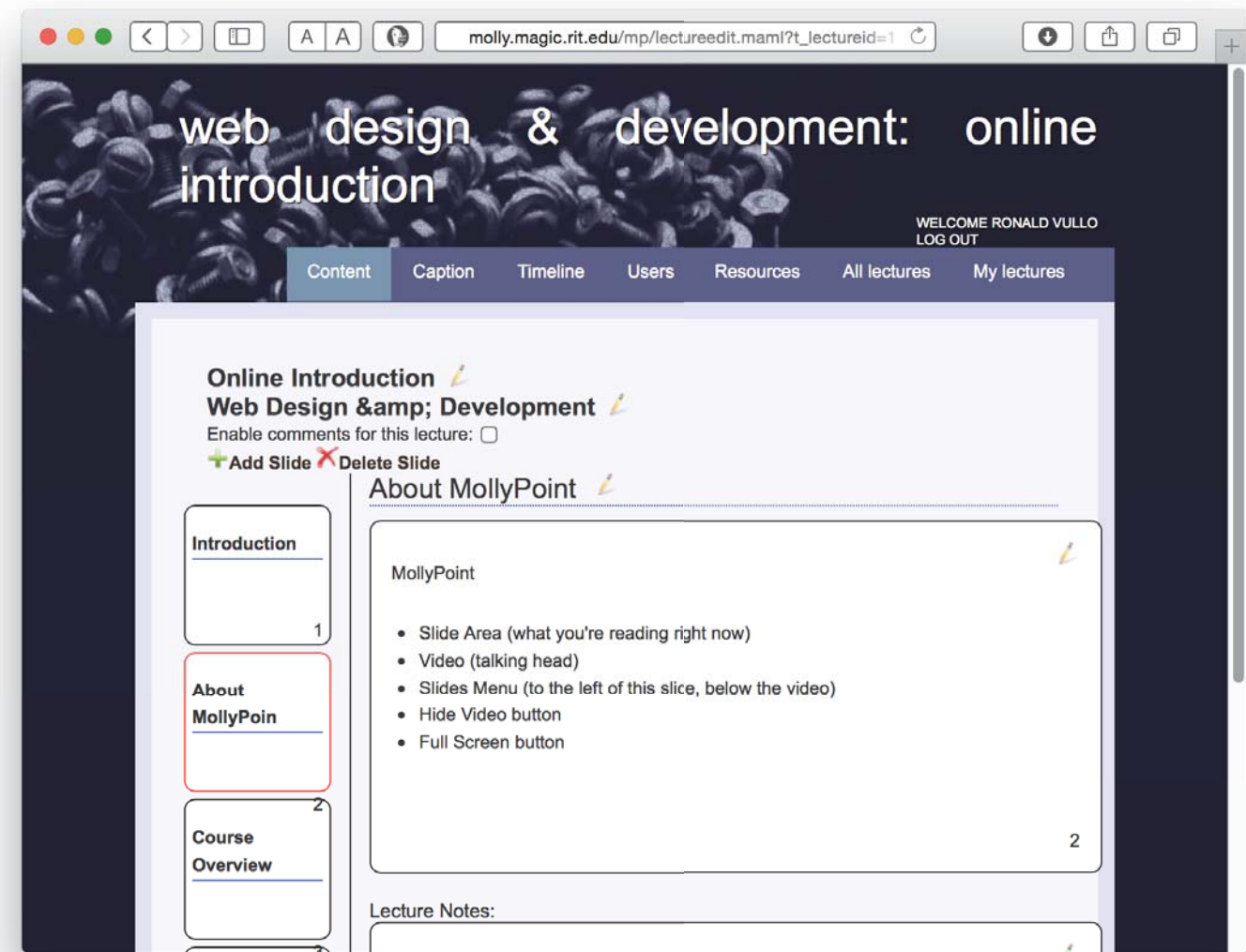
3.2 Business Server Layer

This layer encapsulates the main business rules and services. This layer enforces required parameter validation,

data dependencies and data integrity. The service layer was built with the Molly middleware system (molly.rit.edu) using Molly Active Markup Language (MAML). Molly is built in the PHP server-side scripting language.

3.3 Data Layer

The data layer resides in the MySQL database management system, however Molly uses a database abstraction layer allowing other databases such as Oracle and PostgreSQL to be used if desired. Molly's user login management system (used for authoring permission control) can use a built-in user database, be tied into an existing user database, or as it is currently configured at RIT using the institute's Active Directory (LDAP) system.



4 Technologies and Tools

4.1 HTML5

HTML5 is a new version of HyperText Markup Language (HTML) that has rapidly penetrated the Web market.

First presented in 2004 by the Web Hypertext Application Technology Working Group, the first working draft of the specification was published in 2008. Since then, many browsers have started incorporating HTML5 features. HTML5 was the driving reason for the redesign of the MollyPoint system because it provides APIs for embedding and controlling audio and video content.

4.2 CSS

Cascading Style Sheets (CSS) are a set of rules that define how HTML elements are displayed and positioned on a web page. CSS styles can be defined in-line with HTML elements or imported from a separate style sheet. We used separate additional CSS files for this system, in addition to Molly's built in dynamically generated CSS, to simplify changing and configuring layout and styles of the page. The current version of CSS, CSS3, offers very powerful features to give web developers more sophisticated control over the interface, including rounded corners, multi-column layouts, styling of videos, etc. CSS also permitted us to have slides formatted for printing automatically.

Cross-browser incompatibility in supporting different CSS styles, which leads to display differences, was a challenge for our design and implementation. In some cases, different attributes were used to support different browsers.

4.3 JavaScript

JavaScript is a lightweight, client-side scripting language. It is incorporated into web browsers in order to provide enhanced user interfaces and dynamic web pages. JavaScript uses objects and classes to allow dynamic manipulation of a web page's HTML and CSS via the Document Object Model (DOM). It also allows web developers to respond to user events such as mouse clicks, form input and page navigation.

4.4 AJAX

The acronym AJAX stands for Asynchronous JavaScript and XML, though its definition has broadened over the years to incorporate technologies such as JSON, etc. It represents a set of techniques and an API used to create dynamic web pages by enabling asynchronous communication between the client and server. Using AJAX, the client makes asynchronous calls to the server to send and/or retrieve data without refreshing the whole web page. It can often significantly reduce the users' wait time and allow for a richer range of possibilities for user interactions.

4.5 PHP

PHP (PHP Hypertext Preprocessor) is an open source server-side scripting language used to develop rich web applications. PHP code can be embedded directly into the HTML page. It runs on every common web server platform, including Linux, Windows and Mac OS. Usually PHP is deployed as an Apache module (written in C, so it executes quickly) and makes efficient use of system resources. PHP provides a rich set of libraries and APIs for graphics, database management, XML support, and much more. Because PHP is open source software, there are many sample solutions and considerable documentation available online. Its community provides reliable and quick support.

4.6 MAML

MAML (Molly Active Markup Language) is an XML markup language, developed by students of the Rochester Institute of Technology under the lead and guidance of Professor Vullo. The idea behind MAML is to create a generic library of controls to help abstract complex server-side logic, including database access, so that developers can deploy sophisticated web applications using HTML-like markup in lieu of writing PHP (or other programming language) code.

Molly's XML tags are incorporated into HTML markup, then upon page load, the Molly system parses the included tags and replaces them with the results of functionality written in PHP and SQL.

4.7 JQuery Library

JQuery is an open source JavaScript library developed by John Resig (a former student of Dr. Vullo's) that provides simpler interaction between HTML and JavaScript by abstracting existing DOM APIs and providing cross-browser commonality. JQuery was first released at the beginning of 2006. Today, the leading web development companies, such as Google, Amazon, IBM, and Microsoft, are all using JQuery for developing web applications. According to BuildWith.com, more than 50% of the top web sites are using jQuery libraries. JQuery has a rich library of methods for AJAX development, which were used in developing our system. This library significantly simplified drag and drop functionality for slide reordering. JQuery is available in a minimized version that helps reduce its impact on the pages' load times.

4.8 KineticJS Library

KineticJS is used for slide and video synchronization. KineticJS is a relatively new HTML5 library. It has good documentation and support, quickly gained popularity with the development community. The library is less than 70kb.

4.9 TinyMCE Library

TinyMCE is an open source JavaScript/HTML editor. It provides ability to convert HTML elements including text areas to editor instances. This editor offers a set of built in core HTML formatting tools, such as different font styles and decorations, formatted ordered and unordered lists, style alignments, etc. TinyMCE is integrated into Molly and so was a natural choice for providing authors WYSIWYG slide editing.

5 Caption Authoring System

Once a lecture video has been uploaded for a set of slides, two tabs are added to the authoring/management interface while editing that lecture: Caption and Timeline.

5.1 Caption Tab

Once the Caption tab is displayed for the lecture it can be clicked to access the page which allows the user to: Add captions, delete captions, or reorder captions.

web design & development: online introduction

WELCOME RONALD VULLO
LOG OUT

Content Caption Timeline Users Resources All lectures My lectures

Online Introduction ✎
Web Design & Development ✎

Upload caption(s)

+ Add Caption ✕ Delete Caption

HELLO! I'M DR. VULLO AND ... 1

COURSE. I ALSO CREATED TH... 2

THIS COURSE, AS WELL AS T... 3

TO VIEW THIS LECTURE. BY ... 4

MANY YEARS AGO MY

HELLO! I'M DR. VULLO AND I CREATED THIS ONLINE ✎ 1

The captions for the video can be added in two ways: one caption at a time, or the entire video's captions (i.e. if a script is available) at once. When adding the entire caption content at once, the author can specify an appropriate delimiter option for dividing the text into the individual captions that will display on the screen as the video plays. There are three delimiter options available to the author: CRLF, Custom caption length (i.e. 50 characters), or Custom Delimiter. When adding captions in bulk like this, the system

prompts the author asking whether to overwrite or to append the captions being uploaded to the existing captions. Initially, to start with the time intervals for captions are automatically assigned based on their count and distributed over the length of the video.

5.2 Timeline Tab

The timeline tool allows the author to position both the lecture's slides and the captions along a timeline of the video.

There are two sub-tabs to this tool, Slide Timeline and Caption Timeline, which work in the same way for their respective content. As the video, displayed above the timeline, plays (or is adjusted manually) an indicator moves along the timeline to mark the current position within the video. When the video reaches the appropriate place in the lecture the author can pause the video and move the appropriate slide or caption thumbnail to the position indicated on the timeline. Each line of the captions has a record in the database which is automatically updated by this procedure via AJAX with the correct start and end time code. When the lecture is viewed by the student, the system dynamically generates a .vtt caption file per the W3C specifications for captioning via the HTML5 video tag. These captions can then be turned on or off by the student as they wish.

6 About the Authors

Dr. Vullo is Associate Professor, Department of Information Sciences and Technologies, creator and director of the Minor in Web Design and Development for non-computing Majors, and MAGIC Center faculty affiliate. Dr. Vullo is currently in the process of putting his minor online using the system described in this paper.

Gaurav Kumar and Natalia Ivaniuk are graduates of the master's degree program of the Department of Information Sciences and Technologies.

Ms. Beaton is Associate Professor, Department of Information Sciences and Technologies.

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