JOINING MAPPING SOFTWARE AND CULTURAL REFLECTIONS

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DEDICATION

I would like to dedicate this thesis to my father Pramod Mhasavade, my mother Shubha Mhasavade, my grandfather Madhukar Mhasavade, my grandmother Malati Mhasavade, my sister Neha Puranik, my brother in law Sushil Puranik and my nephew Sahil Puranik for their encouragement and unconditional love. I couldn’t be here without them. I would like to thank my dear friends Apekshit, Dhanashree, Payal, Ameya, Nikhilesh for their continuous support.
ABSTRACT OF THE THESIS

Joining Mapping Software and Cultural Reflections
by
Bela P. Mhasavade
Master of Science in Computer Science
San Diego State University, 2016

Language Acquisition Resource Center (LARC) is a center at San Diego State University which provides courses and programs for learning different languages such as Italian, French, Persian, Spanish, Japanese, Chinese, Russian. It is important to learn the culture of the region/province to learn the language of that province. LARC department has a study abroad program under which students from SDSU go abroad to study the culture of the other countries. We have developed the application to make it easier for students to share their experiences directly with their classmates with the help of interactive maps by uploading the images and videos directly through our system. This application helps professors to teach the courses in more interactive way by showing pictorial presentation of the cultures and allows students to be creative and be able to share their experiences with their classmates.

Motivation behind this thesis is:

a. To make the process of sharing these experiences easier and automated
b. To collect GPS data from the uploaded images automatically and map those images on the map using ARCGIS storytelling map tool
c. To make this application secure and prevent attacks from hacker
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<td>Environmental Systems Research Institute</td>
</tr>
<tr>
<td>UI</td>
<td>User Interface</td>
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<td>CSV</td>
<td>Comma Separated Value</td>
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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

The LARC (Language Acquisition Resource Center) is a center at San Diego State University. LARC supports the teaching and learning of foreign languages in the United States through research, technology integration, and resource development. LARC has many study abroad programs which encourage students to visit the country of the language they are learning.

1.2 MOTIVATION

LARC provides courses and programs for learning different languages such as Italian, French, Persian, Spanish, Japanese, Chinese, Russian. Teachers are always looking for ways to make the teaching interesting and interactive for students. Understanding the geographical structure and cultural values of the country makes it easier and interesting to learn the language. It is really interesting for students to share their experiences with their classmates and teachers when they visit foreign countries. This made need of some tool to share pictures and videos with description. Also, keeping track of the information collected by each student and sharing that information with the students of the class who could not visit the country was the challenge. This demanded a central application to gather all this information. In this era of technology, everything is technology dependent including education. So, there was a need of a web application which will allow students visiting another country to share their experiences with the students and teachers on campus. Also, making the application user-friendly and automated is important need in the fast-paced world.

1.3 OBJECTIVE

- To build a central application for students and professors to upload the images and videos and view them on the map with respect to the location where they
were taken by using ArcGIS’ storytelling template and prepare a tour to view it as a presentation.

- Also, automating this process and trying to minimize the admin intervention
CHAPTER 2

STORYTELLING MAP TEMPLATE

Figure 2.1. Storytelling map

2.1 WHAT IS ARCGIS?

With the help of ArcGIS we can discover, use, make, and share maps from any device, anywhere, anytime. With the help of ArcGIS tools we can collect data, store into interactive maps and share it [1].

2.2 WHAT IS A TEMPLATE?

ArcGIS has variety of templates from which we can select the one which suits our needs.

Naming a few here:

- Crowdsource Reporter: is a configurable group application template that allows users to submit problems/observations. It provides the ability to collect a variety of crowdsourced issues or observations in a single application.
• Impact Summary: is an interactive map which highlights an area and shows a summary of quantitative data related to its location. It highlights using different colors.

• We are using storytelling map template.

We can use this template to display the locations on the map with a brief description, images or videos. This uses the power of maps to tell the story.

How does storytelling map template work [2]?

The template has two versions, namely:

• Option 1: A downloadable version: We can download the template to our server and enhance it as per our requirements.

• Option 2: A hosted version: We can create our tour online on ArcGIS website. We have to sign in to ArcGIS to use this.

We preferred hosted version because it is simple and also the map tours can get automatic updates and improvements made by ESRI. We use an organizational account for this purposes.

The interactive builder gives us two options for handling the images in our Map Tour:

• Option 1: We can use photos that are already online, images stored on our website or server. These images will be referenced in the Map Tour via their URLs.

• Option 2: We can also upload photos from our computer directly into our Map Tour. In this case our photos are stored as attachments with the map tour and not on our server.

We are using option 1 with the option of uploading all the images to our server. So that we will have backup of all the images with us [3].

Then why do we need LARC Mapping System?
CHAPTER 3

LARC MAPPING SYSTEM

3.1 LIMITATIONS OF ArcGIS Tool
If you go to ArcGIS online and create a map,

- You have to enter most of the data manually. For example the link of the image/video, geo-coordinates of the location.
- You may have to create the CSV file (Excel file) which contains all this data.
- If you want to edit the data, you will have to edit the CSV file and upload it again.
- Also, each person (student) will have to create a separate ArcGIS account.

3.2 EXTENDING SCOPE OF ArcGIS Tool USING LARC Mapping System
LARC Mapping System provides:

- It is a user friendly approach to create the maps
- It gives the ability to edit the information that user has uploaded
- It gives an ability to add LESCANT (see section 5.1) tag to each story (image)
- It provides the functionality to filter the stories with respect to LESCANT tags
- Our system provides different privileges to each user. There are three user levels- Student, Admin and Faculty. Admin has the ability to manage user’s information
This system can be used by instructors for their courses to make project assignments.

3.3 HOW DOES LARC MAPPING SYSTEM WORK?
So, in brief, in LARC Mapping system, you will be able to create an account and login to the system. Also, you will be able to upload the images with description and title and also you can view the images plotted on the map from this system.

3.4 HOW TO ACCESS LARC MAPPING SYSTEM?
1. If you go to http://larclab.sdsu.edu/ you will see an option ‘LARC MAPPING PROJECT’
2. When you click on Login on the next page, you will be redirected to our LARC Mapping platform.

3. On the index page of the platform, you will be able to register if you are a new user or you can login if you are a returning user.
CHAPTER 4

REGISTRATION SYSTEM

With our registration system users can signup and then start using the LARC Mapping Platform. Registration requires the details shown in the following form.

![Registration Form]

- Name of a student: User will have to enter first name and last name separately.
- Course: This is a dropdown list of courses. The courses which are already created by admin will be shown in this list.

Figure 4.1. Registration page
- Email id- This is the email id which will be used for logging in to the app
- Password is required for logging in to the app.
- Security Question: User has to set up the security question. This is for the purpose of resetting the password.
- User has to enter the answer to the security question which s/he has selected. We store all this information in our database.
- “I’m not a robot” – Google reCaptcha to prevent bots from automatically registering accounts. Bots can create hundreds of thousands of useless accounts in just a few minutes for spamming or spreading viruses

4.1 Google ReCaptcha

Considering security purposes, we needed some technique to recognise that human is creating an account. Bots can create large number of accounts within a fraction of a second which can blow our system.

Implementation details:

The implementation technique is referenced from [5].

- We are using Google reCaptcha for this purpose. It is a service that protects a website from spams. We need to have a Google account for using this service. I have created following API keys from Google account. There are two keys
  - site key (which is used in HTML code)
  - secret key (which is used in PHP script)
- I have included a javascript file in the html header of the code
- Also, I have added this code snippet in my form

```html
<div class="g-recaptcha" data-sitekey="your site key"></div>
```

It creates a text area which has property set as ‘display:none’, which means it is not visible to the user.

```html
<textarea id="g-recaptcha-response" name="g-recaptcha-response" class="g-recaptcha-response" style="width: 250px; height: 40px; resize: none; display: none; ">
</textarea>
```

- Then in php script we have to check if that text area is found and it is not empty
- We need three parameters to verify that the user is real. Those are:
  - secret key provided by the google reCaptcha
  - user’s IP address
• value of that text area (that is generated from the javascript code)
• We need to pass these three parameters to the URL: https://www.google.com/recaptcha/api/siteverify separated by symbol ‘&’. This URL returns a JSON array.
• We need to check the parameter ‘success’ in that JSON array to validate if the user is not spam/robot.
• Google ReCaptcha provides image captcha as well. If you click on the check box of “I am not a robot” and don’t do anything for a while, captcha will expire and then it will ask you questions like - “Select all the images with cupcakes”. And it shows an error if you miss to select any one of all the images of cupcakes.

Figure 4.2. Registration page with captcha to prevent bots from automatically registering accounts
4.2 Reset Password

There can be the case when the user forgets his/her password. We needed a functionality to reset the password. We had following options to implement this functionality:

- A student will enter his email id used while signing up. We will send out a temporary random password in the email to the user/student which will expire by certain time period.

- Another option was of sending a link (it will be a random link and different for each user) in the email to the user and that link redirect the user to the page where s/he can reset the password. This link will also expire after certain time period.

Sending a temporary password or a link in the email is not secure and hackers can access the data over the network.

So there were a couple of options which can be more secure than the above options but required alteration of current users:

- As email addresses are predictable to the hacker or can be already known to the hacker we considered an option of asking the users to set username when they sign up. A user will enter his username used while signing up and then we will send a temporary password or link in an email to set up one. So that hacker has to know the username of the student.

- Another option was of setting security questions and answers when the users sign up. If the user forgets the password, we can ask him/her the security questions and verify the answers and the allow to set up the password.

Setting up username was complicated and confusing for the users. They will have to remember their username to reset the password which doesn’t serve the purpose. So, after considering all of the above options we selected the option of security questions.

To reset the password, the user has to enter the email address they have used while registering on LARC Mapping Platform. Once you submit the email ID, you will see a security question which you have set while registering on this platform and when you submit the correct answer you will be able to reset the password.
Figure 4.3. Reset Password

Figure 4.4. Security question for resetting password
Students already started using this platform before implementation of this feature of ‘reset password’. I set it up in such a way that whenever the user logs in, we will verify if s/he has set up the security question and if not we will redirect him to the page where s/he will set up the security question and then can start his other activities.

If you enter a wrong answer you will see the following screen:

![Reset Password](image)

Figure 4.5. Wrong answer to security question shows up this message
CHAPTER 5

UPLOAD NEW STORY

This is the section of our application which allows users to upload the images with description and some more details.

On the home page, you will see the following options:

- New story uploads
- Past uploaded stories
- View the map

I will be discussing each of these in detail in next chapters.

Figure 5.1. Admin Home Page
5.1 Details

If you click on the “New Story” on the home page you will see the following page:

This is a feature which will allow the user to upload new image/video with its title and description.

Following are the parameters required from the user:

- **Title**: Title for that image/video
- **Description**: A brief history behind the picture/video. For example when it was taken or if it is representing some historical place, we can add the history behind this place.
- **Icon color**: There are four icon colors we provide- Red, Blue, Green, Purple. These are the colors of pins which will be shown on the map. The purpose of this is to differentiate among the types of images/videos. For example, images representing a place at high altitude can be pinpointed to the map with RED pins while those at sea level can be pinpointed with BLUE pins.

![Figure 5.2. Creating a new story](image)
5.1.1 Image/Video

We are providing an option of uploading image or video. A Map Tour can use videos instead of images or both.

5.1.2 Videos

a. We have created our own video viewing HTML page, say video.html. The link to that HTML page is used to embed those videos in the mapping tour.

b. Implementation details:
   We are using JavaScript here. I am passing the parameters- student ID and the name of the video, into that URL. With the help of javascript, I parse the parameters and access the video stored on the server.

c. JavaScript code:
   ```javascript
   (function() {
     stud_id= getQueryVariable('stud_id');
     file_name = getQueryVariable('fname');
     url_source = encodeURIComponent("/uploads/"+stud_id+"/"+file_name);
     document.getElementById("video").src = url_source;
   })();
   ```

d. HTML code:
   We are using a `<video>` tag which is introduced newly in HTML5.

e. For creating the thumbnails from the videos, I have used FFmpeg plugin [7] Ffmpeg-php is an extension for PHP which provides an object-oriented API for retrieving the data from video and audio files. This can be used to create thumbnail images from the videos. It supports many of the video formats such as .mov, .avi, .mpg, .wmv.

5.1.3 Upload Button

This will provide a dialog box from which the user can select the image or video s/he wants to upload. Recommended image size is 1000 pixels wide by 750 pixels tall. The size of
the file should be less than 500 KB. We store all the uploaded content to our servers. The directory structure we maintain on our server will be explained from the following diagram:

![Directory structure on the server](image)

**Figure 5.4. Directory structure on the server**

### 5.1.4 Capturing EXIF Data from Image

Previously, the user had to enter the geolocation of the image manually. He has to go to the Google maps. Then, search for the location where the picture was taken. Then right clicking on that location gives latitude and longitude of that location.

This was a cumbersome process for the user. We tried to make it more automated by following process.

Now, once you submit the new story, with the image, our system will check for the EXIF data stored with the image and it will retrieve the latitude and longitude from that image and store them into our database. If the image does not contain this data, then our application will prompt the user to enter the data manually. (By the procedure described above)

### 5.1.5 What is EXIF?

**Exchangeable image file format.** This can include date, time, camera settings (such as name of the model of the camera, flash used or not, focal length of the lense, etc.) and
geolocation metadata. You can view this data on the computer by going into the properties of that media file [8].

Sample EXIF data:

You can see in the following sample data, there are the latitude and longitude of the place where the picture was taken. Nowadays most of the cameras and mobile devices have in-built GPS receiver which will store the location of the image where it was taken. The process of adding geographic information to a photograph is known as geotagging.

![Example EXIF data](image)

**Figure 5.5. Example EXIF data**

### 5.1.6 Logic

- I have used following code snippet which will extract the exif data from the image:

  ```php
  $exif = exif_read_data($file_name, 0, true);
  ```

- I have used the following formula to convert degrees, minutes, seconds to decimal:

  ```
  ($degrees + $minutes / 60 + $seconds / 3600)
  ```

  and will multiply the above value with -1, if it is West/South coordinate.
5.1.7 LESCANT Tags

This LESCANT model was created by David A. Victor. He has described this model in his book International Business Communication. LESCANT stands for seven areas in which cultural issues arise when communicating internationally for business purposes. The letters in the acronym stand for the categories: language, environment, social organization, context, authority, nonverbal communication and time [9].

Details of the LESCANT model.

- **Language** – Languages have large impact on cultures. These include attitudes about your own language, insider relationships for those who speak a foreign language, decisions related to which language is used, and how to speak in ways that others will understand you.

- **Environment** – this includes the physical reality such as size, surroundings, population density, climate, food, topography, etc.

- **Social Organization** – this refers to how society is put together. This includes family, education, role of women, class systems, individualism, religion, etc.

- **Context** – this refers to how directly people communicate ideas and words versus how important it is to build a “context” within that communication. Low context cultures focus on the actual words that are spoken, the rules that are written. Those words and rules determine appropriate behavior. High context cultures focus on the situation and shared knowledge, which is what will determine appropriate behavior.

- **Authority** – this category deals with the role of authority figures and how power and decision making is accomplished. Authority also looks at leadership style and the relationship between bosses and their subordinates.

- **Non-Verbal** – here we are considering everything from dress and adornment to colors, touch, smell, and the quality of one’s voice.

- **Time** – this category refers to how people divide time, how they schedule their activities, and how they organize their day [10].

We store the tag for the image in our database. We provide the functionality to view the map with specific tag.
5.2 View the Map with Specific LESCANT Tag

This feature is available only for the Professor/Instructor of the course. S/he can view (or show to the students in class) a map which will display images uploaded by the students in that class and which have the selected tag. It will replace the CSV file accordingly.

We are maintaining the folder structure to store images and videos on server. There is a folder called “uploads” which has folders numbered with the student ID. Also, there is a folder named “courses” in the “uploads” folder which has CSV’s stored with course ID.
CHAPTER 6

PREVIOUS UPLOADS

STORY MAP HOME

Figure 6.1. Faculty Home Page

We have an option of looking back at the uploaded stories and modifying them. When you click on “Past Stories” on the above page, you will be redirected to the following page which will list out all the stories that you have created.

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Icon Color</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Image Url</th>
<th>Video Url</th>
<th>Lescant</th>
<th>Delete</th>
<th>Edit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Image</td>
<td>Testing</td>
<td>R</td>
<td>27.175096</td>
<td>78.04205</td>
<td>Image Url</td>
<td>Video Url</td>
<td>L</td>
<td>Delete</td>
<td>Edit</td>
</tr>
<tr>
<td>testing_self_data</td>
<td>test</td>
<td>R</td>
<td>0</td>
<td>0</td>
<td>Image Url</td>
<td>Video Url</td>
<td>L</td>
<td>Delete</td>
<td>Edit</td>
</tr>
</tbody>
</table>

Figure 6.2. View previously uploaded data

There are options to delete and edit the story. When you go ahead and click on the edit you will see the following page in which you can edit all the information such as title, description, latitude, longitude and the lescant tag.
Figure 6.3. Editing the previously uploaded data

This is the same page which will be shown to the user if the image uploaded by him/her does not have the EXIF(geolocation) data.
CHAPTER 7

VIEW THE MAP

You can view a map by clicking the “View Map” button on the home page. Our system will redirect you to the arcgis website.

7.1 HOW DO WE DEAL WITH THIS MAP ASSIGNING AND MAP CREATING?

- Let’s say there is a class of 30 students starting this summer. We will keep the maps ready for them beforehand.
- Admin has to follow the following process:
  - We are storing the uploaded media files on our server. As it is already mentioned above, we have one folder named “Uploads”. It has subfolders which are numbered with the student IDs. In this step we will create the next 30 folders.
  - As shown in the following image, the admin has to enter the number of students (n) in the class and the system will automatically create the next ‘n’ folders and also each folder will have temporary CSV file which will be overwritten every time you view the map. (‘Why do we need CSV file?’ will be explained later).

  ![Figure 7.1. UI for admin for creating the folders and CSVs on the server](image.png)

- Once we have a CSV file ready, we will create a map from ARCGIS which needs a CSV file to link to. When we create a map on ARCGIS we will provide the URL of this CSV file which is saved on our server.
Each map has a different URL provided by ARCGIS. We will store those URLs in our database. We are providing the UI for the admin to store these URLs along with the student IDs.

![Figure 7.2. Assigning the map to the user](image)

When the user registers, the map gets automatically assigned to that user. Previously, as soon as the user registers, the admin has to go and create a map for that user and then assign it to the user. The user will have to wait for the admin to assign him the map. Till then, s/he can not view the map. Now, we are creating the map in advance and storing the link to it in our database even before the user registers. This reduces the need of immediate availability of the admin.
CHAPTER 8

USER ROLES

8.1 CONCEPT OF A USER ROLE

This is a small part of the system. Whenever a new user registers, we assign the role “student” by default. But “admin” and “faculty” have different privileges. The admin can access the information of all users while faculty can access the images stored by students in his/her class.

8.2 ROLE ASSIGNMENT

The admin has access to this feature. When a new user registers, the admin gets notified by an email, which has the name and the user ID of the user. A faculty member can request admin to give him access to the faculty privileges.

![Role Assignment](image)

Figure 8.1. Assigning the role to the user

8.3 ADMIN RESPONSIBILITIES

One of the objectives behind this thesis is to automate the process as much as possible and reduce the admin intervention. But still there are a few tasks admin needs to take care of. We are providing a page for the admin from where s/he can access all the links to his/her tasks.
8.4 ADMIN CAN ACCESS ALL USERS’ INFORMATION

The admin has access to this page which displays all the information of all the users:
### Users Information

**Story Map Project**

<table>
<thead>
<tr>
<th>STUDENT ID</th>
<th>FIRST NAME</th>
<th>LAST NAME</th>
<th>EMAIL ID</th>
<th>MAP LINK</th>
<th>CSV FILE</th>
<th>REMARKS</th>
<th>MAP URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ravichandra</td>
<td>Chintalapelli</td>
<td><a href="mailto:rchintalapelli@mail.sdsu.edu">rchintalapelli@mail.sdsu.edu</a></td>
<td>User Map</td>
<td>CSV Download</td>
<td>Admin</td>
<td><a href="https://sdsugeo.maps.arcgis.com/apps/MapTour/index.html?appid=c27178663274ce9b37f1477343f82">https://sdsugeo.maps.arcgis.com/apps/MapTour/index.html?appid=c27178663274ce9b37f1477343f82</a></td>
</tr>
<tr>
<td>2</td>
<td>Trevor</td>
<td>Shanklin</td>
<td><a href="mailto:shanklin@mail.sdsu.edu">shanklin@mail.sdsu.edu</a></td>
<td>User Map</td>
<td>CSV Download</td>
<td>Admin</td>
<td><a href="http://arcg.is/1QXtebl">http://arcg.is/1QXtebl</a></td>
</tr>
<tr>
<td>3</td>
<td>Kavish</td>
<td>Ghime</td>
<td><a href="mailto:kavishghime90@gmail.com">kavishghime90@gmail.com</a></td>
<td>User Map</td>
<td>CSV Download</td>
<td>Admin</td>
<td><a href="http://arcg.is/1TVEk2i">http://arcg.is/1TVEk2i</a></td>
</tr>
<tr>
<td>4</td>
<td>Clarissa</td>
<td>Clo</td>
<td><a href="mailto:cclo@mail.sdsu.edu">cclo@mail.sdsu.edu</a></td>
<td>User Map</td>
<td>CSV Download</td>
<td>Faculty</td>
<td><a href="https://sdsugeo.maps.arcgis.com/apps/MapTour/index.html?appid=6b74b0e5339429b40d9ca96cb1e3ca">https://sdsugeo.maps.arcgis.com/apps/MapTour/index.html?appid=6b74b0e5339429b40d9ca96cb1e3ca</a></td>
</tr>
<tr>
<td>5</td>
<td>SDSUItalian</td>
<td>HipHop</td>
<td><a href="mailto:sdsuitalianhiphop@gmail.com">sdsuitalianhiphop@gmail.com</a></td>
<td>User Map</td>
<td>CSV Download</td>
<td>Student</td>
<td><a href="http://arcg.is/1HnezV5">http://arcg.is/1HnezV5</a></td>
</tr>
<tr>
<td>12</td>
<td>Aimee</td>
<td>Masclat</td>
<td><a href="mailto:aimeemasclat@gmail.com">aimeemasclat@gmail.com</a></td>
<td>User Map</td>
<td>CSV Download</td>
<td>Student</td>
<td><a href="https://sdsugeo.maps.arcgis.com/apps/MapTour/index.html?appid=e91da15af1214e9e8811ef9e66a48b38">https://sdsugeo.maps.arcgis.com/apps/MapTour/index.html?appid=e91da15af1214e9e8811ef9e66a48b38</a></td>
</tr>
</tbody>
</table>

*Figure 8.3. Admin can view information of all the users*
The database schema we had before was not ideal. Creating a new table for each user was not a good idea and it was making database clumsy. The problem was that the registration system treats people's names as unique identifiers. Names are not unique identifiers. Two completely unrelated people can have the same name. Each time a new person registers an account on the website, a new table named as a concatenation of the person's firstname and lastname is created in the database. If someone else with an identical name registers on the website, then a new table is not created, but instead they share the same table with the previously registered user, and thus they gain the ability to see other's uploads.

- The schema design which we have now:
Figure 9.1. Schema design

The above diagram illustrates only the foreign key relationships among all the tables.

- **Student** table has all the users. StudentID is used as the foreign key in all the referencing tables.
- **Submissions** table has all the submissions from all the users and which stores the studentID as a foreign key.
- **Maplinks** table has the link to the map of each student and it stores this with studentID as foreign key.
- **Courses** table has the list of courses along with the Professor ID which in turn is again the studentID from the Students table as a foreign key. (Even though the name of the table is Students, it has all the users- admin, professors and students)
- **Security_Questions** table is used to store the security questions required when user registers on LARC Mapping system.
- **Security_Answers** table has answers from the users for the security question they have selected. We store the StudentID and the QuestionID in this table, both of them are foreign keys.

Detailed columns of Students, Submissions and Courses tables are described below.

- **Students**
  
  `studentID` int(9) NOT NULL AUTO_INCREMENT,
<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Nullable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>fname</code></td>
<td>varchar(50)</td>
<td>NOT NULL</td>
<td>First Name</td>
</tr>
<tr>
<td><code>lname</code></td>
<td>varchar(50)</td>
<td>NOT NULL</td>
<td>Last Name</td>
</tr>
<tr>
<td><code>email</code></td>
<td>varchar(50)</td>
<td>NOT NULL</td>
<td>Email</td>
</tr>
<tr>
<td><code>password</code></td>
<td>varchar(100)</td>
<td>NOT NULL</td>
<td>Password</td>
</tr>
<tr>
<td><code>maplink</code></td>
<td>varchar(100)</td>
<td>DEFAULT NULL</td>
<td>Map Link</td>
</tr>
<tr>
<td><code>csvFile</code></td>
<td>varchar(100)</td>
<td>DEFAULT NULL</td>
<td>CSV File</td>
</tr>
<tr>
<td><code>Remarks</code></td>
<td>varchar(30)</td>
<td>DEFAULT NULL</td>
<td>Remarks</td>
</tr>
<tr>
<td><code>courseID</code></td>
<td>int(9)</td>
<td>DEFAULT NULL</td>
<td>Course ID</td>
</tr>
</tbody>
</table>

**Submissions**

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Nullable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>id</code></td>
<td>int(11)</td>
<td>NOT NULL AUTO_INCREMENT</td>
<td>ID</td>
</tr>
<tr>
<td><code>studentID</code></td>
<td>int(11)</td>
<td>NOT NULL</td>
<td>Student ID</td>
</tr>
<tr>
<td><code>name</code></td>
<td>varchar(200)</td>
<td>NOT NULL</td>
<td>Name</td>
</tr>
<tr>
<td><code>description</code></td>
<td>varchar(2000)</td>
<td>DEFAULT NULL</td>
<td>Description</td>
</tr>
<tr>
<td><code>icon_color</code></td>
<td>varchar(2)</td>
<td>DEFAULT NULL</td>
<td>Icon Color</td>
</tr>
<tr>
<td><code>long</code></td>
<td>varchar(20)</td>
<td>DEFAULT NULL</td>
<td>Longitude</td>
</tr>
<tr>
<td><code>lat</code></td>
<td>varchar(20)</td>
<td>DEFAULT NULL</td>
<td>Latitude</td>
</tr>
<tr>
<td><code>pic_url</code></td>
<td>varchar(2000)</td>
<td>DEFAULT NULL</td>
<td>Pic URL</td>
</tr>
<tr>
<td><code>thumb_url</code></td>
<td>varchar(2000)</td>
<td>DEFAULT NULL</td>
<td>Thumb URL</td>
</tr>
<tr>
<td><code>is_video</code></td>
<td>varchar(2000)</td>
<td>DEFAULT NULL</td>
<td>Is Video</td>
</tr>
<tr>
<td><code>lescant</code></td>
<td>varchar(20)</td>
<td>DEFAULT NULL</td>
<td>Lescant</td>
</tr>
</tbody>
</table>

**Courses**

<table>
<thead>
<tr>
<th>Field</th>
<th>Type</th>
<th>Nullable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>id</code></td>
<td>int(9)</td>
<td>NOT NULL AUTO_INCREMENT</td>
<td>ID</td>
</tr>
<tr>
<td><code>name</code></td>
<td>varchar(255)</td>
<td>DEFAULT NULL</td>
<td>Name</td>
</tr>
<tr>
<td><code>prof_id</code></td>
<td>int(9)</td>
<td>DEFAULT NULL</td>
<td>Professor ID</td>
</tr>
<tr>
<td><code>maplink</code></td>
<td>varchar(100)</td>
<td>DEFAULT NULL</td>
<td>Map Link</td>
</tr>
</tbody>
</table>
CHAPTER 10

OVERCOMING SECURITY BREACHES

- **Cross-Site Scripting Attacks** [11] - Certain parts of the website were vulnerable to XSS attacks. The edit page can be used to inject javascript (or any other web language) into the database, which is typically used to steal information or redirect the browser.

  **Preventive measure:** Escaping HTML is the solution for this. PHP has an inbuilt function htmlspecialchars() which removes the special characters used in the submitted data before the system processes it.

- **No Bot Mitigation** [11] - The registration page did not have any sort of CAPTCHA or email confirmation to prevent bots from automatically registering accounts. Bots can create hundreds of thousands of useless accounts in just a few minutes for spamming or spreading viruses

  **Preventive measure:** Use of reCaptcha (Refer section 4.1)

- **No Password Protection on Admin Pages** [11] - Certain pages should be accessible to just the admin, such as access to the user database or assigning a map to the user; these pages did not have any sort of protection on them. Anyone that can guess the page URL can navigate to them, allowing them to see all of the registered users' names, email addresses, whereabouts, access level, and allowing the attacker to change the students' map assignments.

  **Preventive measure:** Creating a role for the user such as Student, Admin, Faculty. We are storing this role in the students table and when the user tries to access admin pages, we first check the role of the user and if s/he is not admin we redirect the user back to the home page.

- **SQL Injection** [11] - Someone can inject database queries through the user interface and can try to manipulate the information in the database or can try to destroy the whole database.

  **Preventive measure:** Whenever we insert any data into the database, we have to escape the data with this function in PHP mysql_real_escape_string(). A hacker can try to insert the database query with the data which can destroy the database.
• **Use of HTTPS over HTTP** [11] - Login and registration pages were not being handled securely over SSL encrypted HTTPS. This means that any registration information sent to the server is being sent unencrypted, which can be read by anyone else on the network. Also, the university requires us to handle registration and logins over SSL.

**Preventive measure:** Use of HTTPS instead of HTTP
CHAPTER 11

OBSTACLES

- As we are storing all the uploaded media files on our server, we needed our own video hosting page. Initially, we chose to have one page for each video but that was not a scalable solution. Then we opted for a solution of creating a single page for all the videos which requires the use of Javascript.

- Also, when we uploaded a video, we were not able to create thumbnails for these videos. For the uploaded images we use the same image as thumbnail, but for the videos we had to capture an image from the videos. This was a challenging task. I have used FFMPEG plugin for that.

- When we added the functionality for resetting the password, we used the method of security questions. However, for the users who were already registered we did not have their data (such as security question and answer to security question). We had to set up something to get their data. So everytime when a user logs in, we check if we have their data required for resetting the password and if we don’t have that we redirect them to the page where they can select the security question and enter an answer to that question. We were already collecting this data from the new users upon registration but we had to set up the system as described for the old users.

- Versioning of code: We are not using any code versioning system in our application, which makes it difficult to look back to see what changes I have made. Every time copying the code files before modifying was cumbersome and was not efficient.
CHAPTER 12

FUTURE ENHANCEMENTS

• Hardcoded URLs and Email Addresses - Certain areas use the full server addresses "http://larcmaterials.sdsu.edu/larcmapping/..." when a relative address would have worked fine. This is not a security issue, but certain parts of the site would stop working if the website was either moved to a different folder, moved to a different server, or if the site was accessed securely via https rather than http. Likewise, I noticed that some email addresses are hardcoded on several pages. If those email addresses needed to be updated at some point, the code for all of those pages would have to be updated. It would be better to have that sort of information either stored in one spot, or give an 'administrator' the ability to change these parameters without having to edit the code.

• Supporting different languages - As the purpose behind this application was prominently study abroad programs, it will be useful for the users to include the description of the pictures taken in different countries in the local language. It will be useful to give the references.

• Capturing GPS data from video: We already have the functionality for the images to capture the EXIF data from the image, and similarly we can do this for the videos.

• When the image does not have the EXIF data, user has to manually enter the latitude and longitude by finding it from Google Maps. We can implement the functionality to auto populate the location when you start entering the name of the location in the text box. (Using Google maps APIs)

• Downloading a template to the server: We can download the template to the server and make modifications as required such as adding a logo to it.

• CSS and website design: Currently the user interface we have is minimal. We can make it more attractive by adding appropriate CSS to it.

• Github: Using github to store the code of this application, which makes it easier to collaborate and which provides version controlling of the code. I faced this issue when I was working on this remotely.
REFERENCES


APPENDIX

ADMIN MANUAL FOR CREATING MAP IN ARCGIS

1. We have all the data of the user in our database. We have a folder to store media files uploaded by the user on the server. In the “Uploads” folder, we have a folder which will be named after student’s ID. This folder contains the csv(spreadsheet) file which will contain all the details of each image such as the name, caption, location, and media URL.

2. Go to ArcGIS online website through https://www.arcgis.com/home/signin.html.

3. Log in to the online system using credentials provided to the map administrator from the Lab.

4. Go to ‘My Content’ and click on Create > Map
5. After creating a map (viewed in ‘Map Viewer’), add the user’s CSV file located on the server in his folder. Assign the complete server path of the CSV file to the Map as follow:
Click on ‘Add’ > Add layer from web > select ‘A CSV file’ from the drop down menu > enter the path of CSV file in ‘URL:’ > Click on Add Layer
Example of the server path for CSV files of student ID 1 (to be added in ‘URL ’):
http://larcmaterials.sdsu.edu/larcmapping/uploads/1/1.csv


7. Adjust the map to specific location if required

8. Now, share the map from the Map Viewer, in order to create the Story Map template for that user.
9. After creating the story map, make the following changes in the Web Application:
   a. Go to Builder Mode (can only be accessed if logged in to the ArcGIS online website)
   b. Change the ‘Student #’ to user’s name and add details if necessary
   c. Click on Settings
   d. Add LARC Logo under: Header > Custom Logo (first text box) > add ‘http://larclab.sdsu.edu/images/logo3.png’
   e. Change the template color under: Colors
   f. Click on ‘Save’ after making all the changes
   
   The short URL of this web application is available on the top-right corner of the application above the LARC logo. This URL is used to update user’s map link using the Map Assignment module shown in Figure 1.

10. Go to ‘Map Assignment’ module and enter all the details. For the Map URL, go to My Content > go to the Student # > click on the Student # under the type ‘Web Mapping Application’ (Story Map application is opened) > click on the hyperlink symbol located at top-right corner and copy the short URL.

   After assigning the map, the column ‘Map Link’ in the ‘studentTable’ is updated with the hyperlink User Map. Also, after the map is assigned the user gets notification through email, and now he/she can access their story map web application template through the ‘STORY MAP’ button located on the Home page of the LARC story mapping system.