AC 2011-2280: MOUNT TIMPANOGOS COMMUNITY SPECIES DATABASE

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MOUNT TIMPANOGOS COMMUNITY SPECIES DATABASE

Abstract

The Biology Department at Utah Valley University runs the Mount Timpanogos Community Biology Project. We were approached by a professor of our Biology department to design a database for his project. The aim of the project is to document the various plant species found on Mount Timpanogos. Researchers involved in the project will hike the mountain and take a photograph of the various plant species they encounter. Along with the photograph they record the exact latitude and longitude and elevation of each plant. The goal is to get an accurate picture of all of the plant species on the mountain, where they are located, their climate, and temperature range.

In this project we built a database and allowed access to it via PHP. We designed the database to be accessed on the family, species and specimen levels. The search capabilities were designed to give as much flexibility to the user as possible. Users can search for plants by family scientific name, family common name, species scientific name, species common name, latitude range, longitude range and elevation range. Currently this database is available to users world-wide free of charge.

Introduction

The Biology Department at Utah Valley University runs the Mount Timpanogos Community Biology Project. The aim of the project is to document the various plant species found on Mount Timpanogos. Researchers involved in the project will hike the mountain and take a photograph of the various plant species they encounter. Along with the photograph they record the exact latitude and longitude and elevation of each plant. The goal is to get an accurate picture of all of the plant species on the mountain, where they are located, their climate, and temperature range. We were approached and asked if we would take on the project of building an online catalog for the collected data and photographs so that it could be shared with the community and world at large. We undertook the project in the spring of 2009. We built a database and allowed access to it via PHP. We designed the database to be accessed on the family, species and specimen levels. The search capabilities were designed to give as much flexibility to the user as possible. Users can search for plants by family scientific name, family common name, species scientific name, species common name, latitude range, longitude range and elevation range. If a person is unsure of what they are looking for they can browse the catalog by clicking on a family, species or plant name. Each specimen is accompanied by a high-resolution photograph, latitude, longitude and elevation information. Users may also see a map of their search results using Google Earth. The Google Earth plug-in maps each search result on a map of the mountain and gives the user a complete picture of the location, proximity and distribution of the results of their search.

Project Implementation

During the Spring semester in 2009 at Utah Valley University, our Advanced Database Topics class was approached by our instructor with a plan for a possible database project. He asked us if we would be interested in designing a database to organize Geo located specimen photography samples for a local volunteer biology project on Mount Timpanogos - a project that originated by a biology instructor at the same university. As a class, a few of us were already interested in gathering and organizing data from a biological point of view, and this was a great opportunity to accomplish what we wanted as well as to create a database as an extra-curricular class project.

We chose to implement this application and provide access to our new database through the use of PHP. Fortunately, we were provided some server space to accomplish our task on a windows server, given temporary Remote Desktop access to build our database initially using Microsoft SQL Server as the DBMS and to upload the photos - from there we built a web application to display the information, and to provide a "back-end" interface access to all database tables for advanced users to classify and rate the photos, as well as to add or modify specimens as needed.

The application is eventually to be used by any volunteers taking their own Geo located photos of flowers and plants - they would upload the results of their work through this web application. The samples at that point would wait in a queue to be approved by the project manager and a team of specialists who would rate the photos and classify the information with the correct scientific names before being published to the site for the world to see.

Anyone who has access to the Internet can see the application through the following URL: http://science.uvu.edu/timp/. Currently, only the Professors involved in this project and the students who built the site can add or modify samples to the collection. We began developing a photo upload tool for anyone to be able to add to the collection later.

Working on the project, we discovered that the photos are hi-resolution, and are very slow to load in a web browser. After realizing that the photos we were given were too large to display in sets of more than 1, we decided to re-size them and create "thumbnail" versions to display when researchers were running requests against the application. Once the user has found a specimen they want to look closer at, they can click the image for the hi-resolution version, which opens the hi-res version. The photos rated at a level "5" are absolutely stunning!

The user interface allows drilling down and hunting for specimens given all available options, the same interface with different controls depending on if the user has admin rights or normal user rights:

Mt. Timp Community Biology Project {Backend}

Index - •Search•Family List•Species List•Specimen List•User List•Admin•Logout•About•Help
welcome to the specimen catalog... what would you like to see?

Family Scientific Name: [   ]   Family Common Name: [   ]   Species Scientific Name: [   ]   Species Common Name: [   ]

Specify Wild-cards (%): ☐ **7**

12 LAT >= [   ]   LAT < [   ]
LON >= [   ]   LON < [   ]
ALT >= [   ]   ALT < [   ]

Show SQL: ☐ **9**
Show Google Earth: ☐ **6**
Show Unapproved Only: ☐ **8**

11

James G. Harris (6641)	Pinaceae	Pine Family	Abies concolor	White fir
Melinda Woolf Harris (0)				
Wayne H. Whaley (2)				

[Search!]

[Start Over] **10**

5	Altitude	Latitude	Longitude	Who
edit specimen	999999	5.00	5.00	Wayne H. Whaley edit user
edit specimen 5	5.00	5.00		Wayne H. Whaley edit user **3**

1	# Sampled	**2** Family Scientific Name	Family Common Name	Species Scientific Name	Species Common Name	Avg/Max/Min Altitude	Avg/Max/Min Latitude	Avg/Max/Min Longitude
	9	Pinaceae edit	Pine Family edit	Abies concolor edit	White fir edit **4**	112585 999999 5	32.57 40.45 5.00	-85.74 5.00 -111.70

[click to expand]

1. **# Sampled:** click to expand the actual specimen rows above the results table (see 5), also - each value of every field is clickable - in this row, the user can change what the search criteria is dynamically (without needing to use the controls above the results table - see 12 or 11 above for example).

2. Clicking on the column headers will sort the list either ascending or descending on a rotation, click on the column after the page refreshes and it will sort in the opposite direction for you by the field indicated by the column.

3. Avg, min, max - these links will sort the results by the following see # 1 for more details.

4. These 'edit' links will allow admin users the ability to go in and edit this information.

5. Specimen results after clicking # Sampled: this list is currently limited results, so if there are 20 species in the original table, and 10 specimens for each species, you will see all 10.

6. Google Earth plugin - as long as the client has google earth plugin installed, and running Internet Explorer, the user can check this box and submit the form, and will see google earth zoom in to Mt. Timp and display up to 25 specimens based on their search criteria!

7. Specify Wild-cards % - users may check this box and enter specie/family names like: Dog%d - which would return all rows matching Dog*d - anything between Dog and the letter d for the given field - users may get fancy with the wild-cards as well such as: %D%w% - so the results would have to have a D followed by a w somewhere in the value given in the search boxes above the checkbox. This has recently been changed to do this automatically if a % is included in any of the search boxes.

8. Show Unapproved Only - admin user functionality - shows only unapproved uploaded specimens for approval purposes.

9. Show SQL - allows admin users to view the sql they are generating when using the form and various functionality - also a good way to debug problems should they arise.

10. Start Over - what else? It resets the session and the query string to start fresh.

11. Possible values based on other search criteria - given an altitude of 1000, these 4 boxes would only show possible values based on that criteria.
12. Lat/Lon/Alt - ability to specify ranges for these values - if you leave one out, the other will be included only.

The interface has undergone some improvement in the few years since it was first built. Here is an example of how it looks today (as of December 2010), some of the controls have changed and the user interface is simpler for the standard user:

The samples taken through these cameras also record the elevation, latitude and longitude of each photo, by passing this information to Google Earth through our web application to their latitude API, we can locate the exact reference position of the specimens taken and we display a

little image next to the selected species for each of the various points on the mountain that specimens were taken.

Here is an example of a Google Earth distribution of the Asteraceae Sunflower Family (after clicking on one of the red bubbles in the Google Maps screen below):
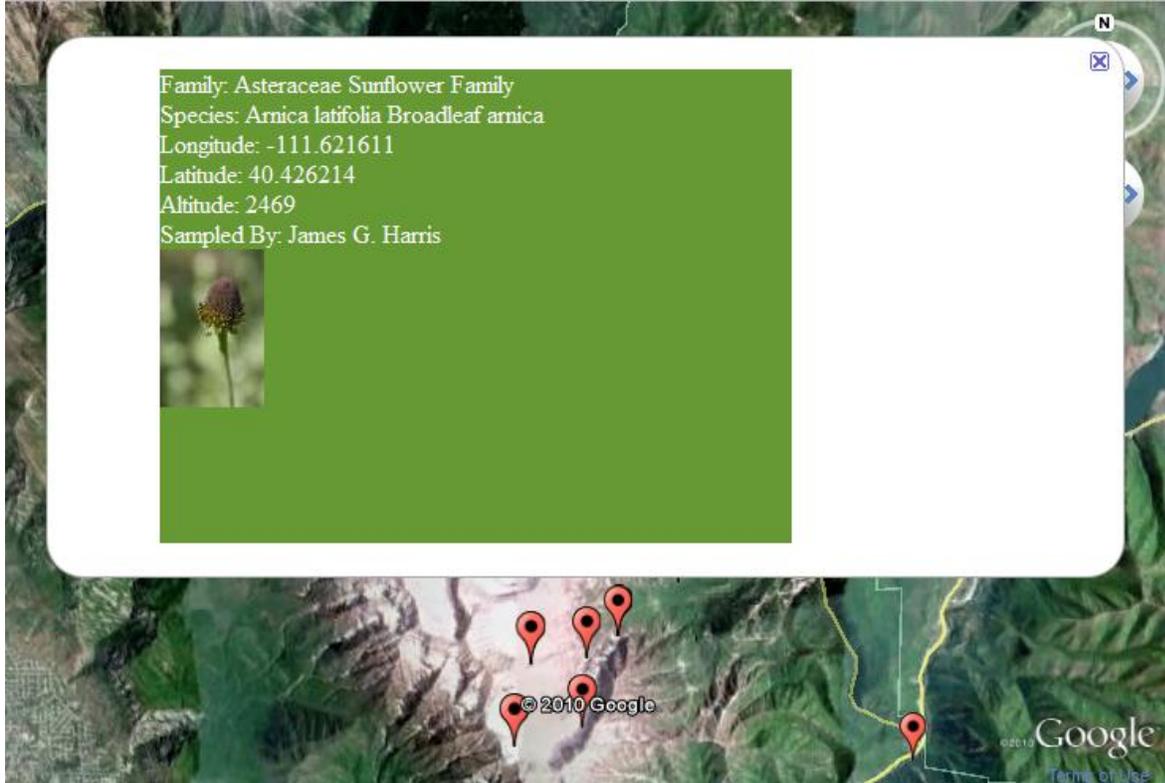
Sample Code for Implementation

Here is a sample database structure for specimen, species and family tables:

```
[SPECIMEN] => Array
    (
        [SPECIMENID] => CEDED931-E053-41BB-8DB8-0002F8308735
        [USERID] => 4939A6E8-4D2D-4EE7-955E-BF75CCC3ACF7
        [PHOTOID] => 1996D064-D87D-4F3F-9535-3711C2479EF4
        [SPECIESID] => 691F298E-B996-4A0E-94CE-56352DEF2C47
        [LAT] => 40.386499
        [LON] => -111.626599
        [GPS_ALT] => 3042
        [SUBJECT] =>
        [ENV] =>
        [CREATE_USER] =>
        [UPDATE_USER] => 5D146823-B909-4490-8EE6-57C6E811911B
        [UPDATE_DATE] => DateTime Object
            (
            )
```

```
                [CREATE_DATE] =>
                [APPROVED_DATE] => DateTime Object
                  (
                  )
            )

        [SPECIES] => Array
          (
                [SPECID] => 691F298E-B996-4A0E-94CE-56352DEF2C47
                [FAMID] => 8E05B58C-8208-4CD9-BBF5-351AFB0EB092
                [SCIENTIFIC] => Hackelia unidentified
                [COMMON] => unidentified
                [CREATE_USER] =>
                [UPDATE_USER] =>
                [UPDATE_DATE] =>
                [CREATE_DATE] =>
          )

        [FAMILY] => Array
          (
                [FAMID] => 8E05B58C-8208-4CD9-BBF5-351AFB0EB092
                [SCIENTIFIC] => Boraginaceae
                [COMMON] => Borage Family
                [CREATE_USER] =>
                [UPDATE_USER] =>
                [UPDATE_DATE] =>
                [CREATE_DATE] =>
          )
```

Conclusion

Our main purpose was to design a database to house the data as this was the topic for our class. As a side benefit, we all learned more about gathering biological samples and organizing them in such a manner that other people would be able to research and find photos for the different plant life on Mount Timpanogos on the Internet.

We have already seen traffic from different parts of the world that seem to be interested in the photos and the documentation. This database that includes documentation on the Geo located plant life can be extremely helpful to those looking for ingredients to herbal medicine to discover where specimens can be found. This project can be expanded to include Geo located photographs and documentation world-wide. Similar works have been done by others for different purposes[1,2,3,4]. Interested users may brows through the following web sites listed as references.

References

1. http://www.unep-wcmc.org/species/dbases/about.cfm
2. http://www.issg.org/database/welcome/
3. http://nas.er.usgs.gov/
4. http://plants.usda.gov/java/