University of Arkansas – CSCE Department
Capstone I – Final Report – Fall 2020

Ozark Creek Gauges

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Abstract

The Arkansas Canoe Club has a web page that informs boaters about current water levels for most of the floatable streams in the Ozarks and Ouachita mountains. This data is derived from the United States Geological Survey (USGS) stream gauges. This information allows boaters to see streams that are at optimal levels, which are too low and which are too high on a given day. This is a highly used site for paddlers in and around Arkansas, but this website has not been updated in approximately 20 years, which means that the readability and overall user experience is poor. We have also noticed that certain rivers are not updated often, so the statuses of particular rivers can be inaccurate.

For this project, we aim to update the website to allow for more easily understood information and an overall better user experience. To do this, we will use the existing code that is written in Perl and use Python to create new functionality that allows users to add additional streams to the program. We will also have a function to monitor user inputs which will combine streamlines, the path of a river, that are currently in the site, with streamlines that the users input. Not only do we want to update the look of the website, but we also want to add additional prediction functionality to better estimate which streams are rising or falling during and after rainfall. With these changes, we seek to better inform paddlers of streams that are not or soon will not be in suitable conditions for paddling. We feel these changes could help prevent injury or even death.

1.0 Problem

The issue with the current Ozark Creek Gauges website is that while the information is mostly accurate, the overall site needs updating. Due to naturally occurring changes such as streambed depth, the range that designates water levels is not as accurate as it was years ago, therefore the low, optimum and high designation levels of some streams may be somewhat inaccurate. Current users with knowledge of how Arkansas streams react to rainfall often just know what the optimal water level is and can predict which streams are soon to be too high, or too low. But new users of the site would not have this knowledge and could assume that rivers

marked as being in an optimal range are safe, when they actually are not. Data about each river is displayed in a flat chart and the measurements can be difficult for people to interpret. If the user does not take the time to really study the data found on the site, he or she may be turned off from even using the website. Information on the website is limited to the creeks and rivers contained in the table. More users would be drawn to the page if the data was in a more readable and interactive format, with insight into rivers with good conditions, and the ability to interact through filtering desired areas. Aside from the photos included by some of the creeks, there is no additional functionality other than reading creek statistics. This, paired with the minimal design, makes the website not very appealing or fun to use.

2.0 Objective

The objective of this project is to redesign the Ozark Creek Gauge Website to give boaters a better user experience. We will also add a Google Map interface that will show streamlines in polygons and put-ins, take-outs, and rapids using markers. Put-ins and take-outs are where boaters can enter or exit a specific stream. A marker is used to define a specific location on a map. When users select a streamline marker, the water gauge will be shown for that river. Another feature we are adding will to allow boaters to draw new streamlines if a river doesn't already have one created. To do this they will be able to use polygons to map out the new streamline. The USGS website provides river gauge updates that vary from 1 hour, 4 hours, 24 hours, and 7 days. Using these updates, we could predict the conditions of rivers with the data collected. These updates will give boaters, from beginner to experienced, the information needed to determine which rivers are most suitable for paddling on a given day.

3.0 Background

3.1 Key Concepts

The first, and most important technology is the Ozark Creek Gauge Website that we will be building off of. The current website generally shows a more simplistic version of what our end goal will look like. It shows the international river difficulty rating, watershed size and current level of specific waterways in the area. It takes data from the USGS gauge system in order to keep the information current and accurate.

Our next concept is the USGS gauge and the national weather service rainfall estimate. They are both government websites that will give us information about the waterways. The gauge often gives us information about how much precipitation has fallen on a given area at a given time. The rainfall shows the amount of precipitation that a certain area gets. We can scrape the information off both of the sites and use them for our application in ways that are useful and readable for boaters. It will give them all the valuable information they looked for in the original page, but in a way that is easier for the user to understand.

Another key technology that we will be using is Google Earth. Google Earth is where we will be implementing the map and all its features. It will be the base map where we overlay all of

our features. From the sketches of the waterways to the rainfall estimates, they will all go on top of the map. Google Earth has built in features we can use, and the flexibility allowing us to implement our own features inside the map.

3.2 Related Work

There are several other projects that are similar to ours, such as Paddle Wisconsin [1], but ours has several key features that are different from the other projects. For one, ours will be more in depth than the others. Most of the examples we have seen do not give reliable updates on the water levels, instead only say which seasons streams are most likely navigable. Our redesigned site will give current and reliable water levels so a user will know if the waterway is navigable right now.

A unique feature ours will include is functionality allowing users to add waterway data. With single user generated maps, it is very easy for some waterways to get left behind. The creeks and rivers may be running through private land, or only navigable during a small window of opportunity. With our map, a user will be able to add a creek or stream that they have floated to ensure that no creek gets left out in the map. This functionality adds to the overall accuracy and detail of the site.

4.0 Design

4.1 Requirements and/or Use Cases and/or Design Goals

The goal of this project is to make the Ozark Creek Gauge website more readable, useful for non-experienced boaters, and add more functionality to it. Therefore, there is more info that a user could get to make their boating trips as safe as possible. There are going to be different tabs on the newly designed website.

1. Design the website using a new web framework to make it more up to date and readable
2. Homepage tab requires:
    a. Paragraph of general information for the website
    b. List of water levels for rivers in the Ozark area and will include:
        i. River class and size, current water level, the last gauge reading, water gauge with USGS website hyperlink, and optimal water levels for that river
    c. Extensive key for users to fully understand the different aspects listed for each river
3. River map page tab requires:
    a. Implementing Google Maps onto page
        i. Show polygons of the rivers mapped out
            1. When user hovers over the polygon it should display the river name, put-ins and take-outs, and current water level
                a. “Put-ins” are where a boater can enter the river

        b. “Take-outs” are where a boater can exit the river
    ii. Users can sketch out their own paths for rivers and create markers for put-ins, take-outs, and rapids
        1. Markers will be placed where the put-ins, take-outs, and rapids of a river are and will have different icons to differentiate them
            a. Make keys of different marker icons for the put-ins, take-outs, and rapids
        2. Determine a way for the user to have a “report” button
            a. If there is misinformation, users will have the ability to report any such issues. The contents reported will be taken off the site until it’s reviewed
b. Making a database for the polygons to be stored in and updated
    i. Polygon of the stream paths with their put-ins, take-outs, and rapids markers
    ii. Polygons stored so boaters can look on the website and see the gauge information on a map
4. Create rainfall database to use data from the weather to predict how the water gauges might react

4.2 High Level Architecture

The current website is a single page with the gauge information all written in Perl over 20 years ago. For this project, we will be using a web framework to make the new redesigned site. We will redesign it to where the home page uses the current Ozark Creek Gauge Perl code and make a new tab that allows it to implement Google Maps to see river gauges on a map.

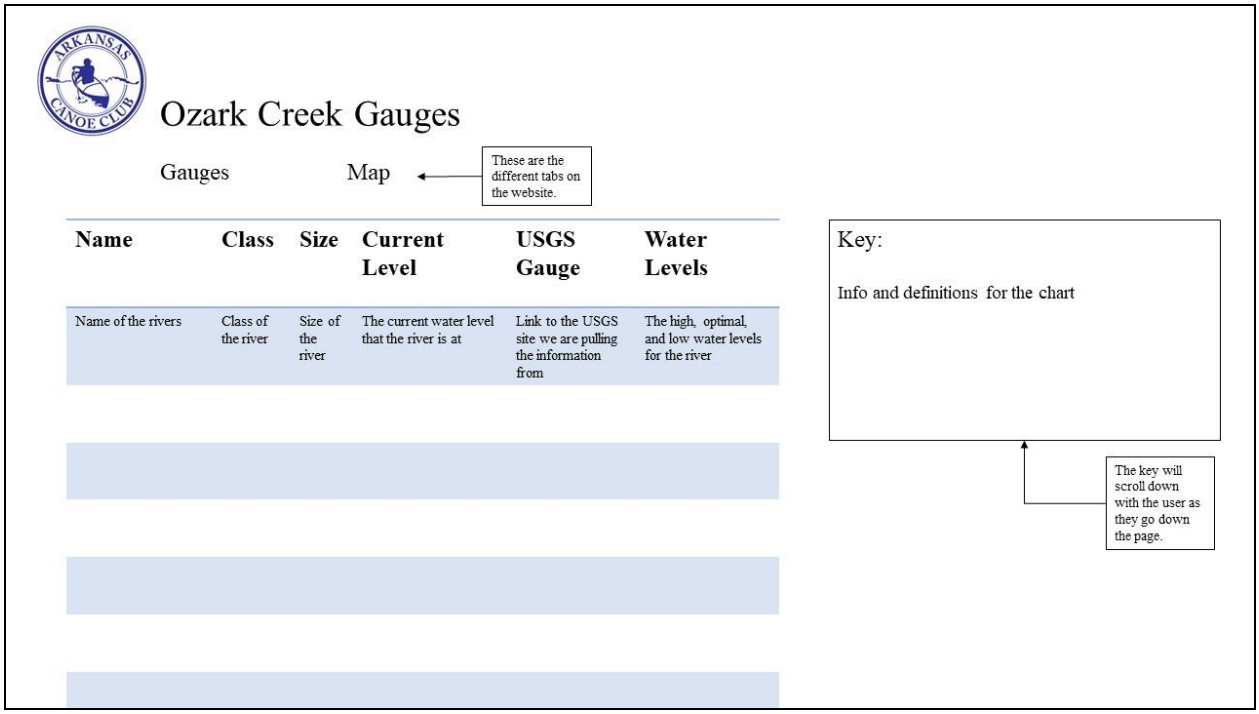
Ozark Creek Information Summary

Last Page Update: 11/12 11:38

Name	Rating	Size	Level	Ref. Gauge	Time	C.Q.	Photos
Fisher's Ford	PLAY	A	L →	USGS: Illinois R. nr Siloam Springs 2.87 [2.1, 3.7, 5]	11/12 11:15 (0.3 hr)	A	
Dragover (Ouachita R.)	I-II	L	L →	USGS: Ouachita River nr Mount Ida 2.99 [2.75, 3.5, 6.5]	11/12 10:45 (0.8 hr)	A	
Saint Francis R. (MO)	II-IV	L	L →	USGS: St. Francis River near Roselle 3.23 [3, 4, 8]	07/08 09:30 (3051.1 hr)	A	
Cadron Cr.	I-II+	L	L →	USGS: Cadron Cr. nr Guy 1.52 [1.5, 2.0, 6]	11/12 11:00 (0.6 hr)	A	
Mulberry R. (below Hwy 23)	I-II	L	X →	USGS: Mulberry R. nr Mulberry 1.67 [1.7, 2.3, 5]	11/12 10:30 (1.1 hr)	A	
Caddo R.	I-II	L	X ↘	USGS: Caddo R. nr Caddo Gap 5.2 [5.3, 5.75, 7.25]	11/12 10:45 (0.8 hr)	A	
Mulberry R. (above Hwy 23)	II	L	X →	USGS: Mulberry R. nr Mulberry 1.67 [1.9, 2.8, 5]	11/12 10:30 (1.1 hr)	A	
Big Piney Cr (blw Longpool)	I-II	L	X ↘	USGS: Big Piney Cr at Hwy 164 nr Dover 0.89 [1.2, 2.0, 5.0]	11/12 10:45 (0.8 hr)	A	
Illinois Bayou	II	M	X →	USGS: Illinois Bayou nr Scottsville 5.6 [6, 7, 8]	11/12 10:30 (1.1 hr)	A	
Buffalo R. (below Ponca)	I-II	L	X →	USGS: Buffalo R. at Ponca 2.25 [3.0, 3.7, 6.3]	11/12 11:15 (0.3 hr)	A	
Cossatot R.	II-IV	L	X →	USGS: Cossatot R. at Vandervoort 2.24 [3, 3.4, 5.5]	11/12 11:15 (0.3 hr)	A	
South Fork Little Red R.	I-III	M	X →	USGS: S Fk Little Red R. at Clinton 4.42 [5.5, 6.5, 8.0]	11/12 11:00 (0.6 hr)	B	
Big Piney Cr (abv Longpool)	II+	L	X →	USGS: Big Piney Cr at Hwy 164 nr Dover 0.89 [2.0, 3.0, 5.0]	11/12 10:45 (0.8 hr)	A	
Roger's Private Idaho	II	L	X →	USGS: Strawberry R. nr Poughkeepsie 1.37 [2.5, 3.7, 6]	11/12 11:00 (0.6 hr)	A	
South Fourche Lafave R.	II+	L	X →	USGS: South Fourche LaFave nr Hollis 2.29 [3.5, 4, 6]	11/12 10:45 (0.8 hr)	A	
Illinois R. (Hogeye Run)	II+	S	X →	USGS: Baron Fork at Dutch Mills 2.25 [3.5, 5, 6]	11/12 10:30 (1.1 hr)	C	
Little Missouri R.	II-III	S	X →	USGS: Little Missouri R. nr Langley 3.45 [4.75, 6, 8]	11/12 11:00 (0.6 hr)	A	
Fall Cr.	II-IV	S	X →	USGS: Baron Fork at Dutch Mills 2.25 [3.75, 5, 6]	11/12 10:30 (1.1 hr)	C	
Richland Cr.	III-IV	M	X →	USGS: Richland Cr. at Witts Springs	11/12 10:30	A	

Current Ozark Creek gauge website - still functions how it was originally made. However, the information on the website is not easily digestible for beginner boaters and new users of the site. A key is provided at the bottom of the page, but unless you know paddler terminology it is hard to follow and to understand.

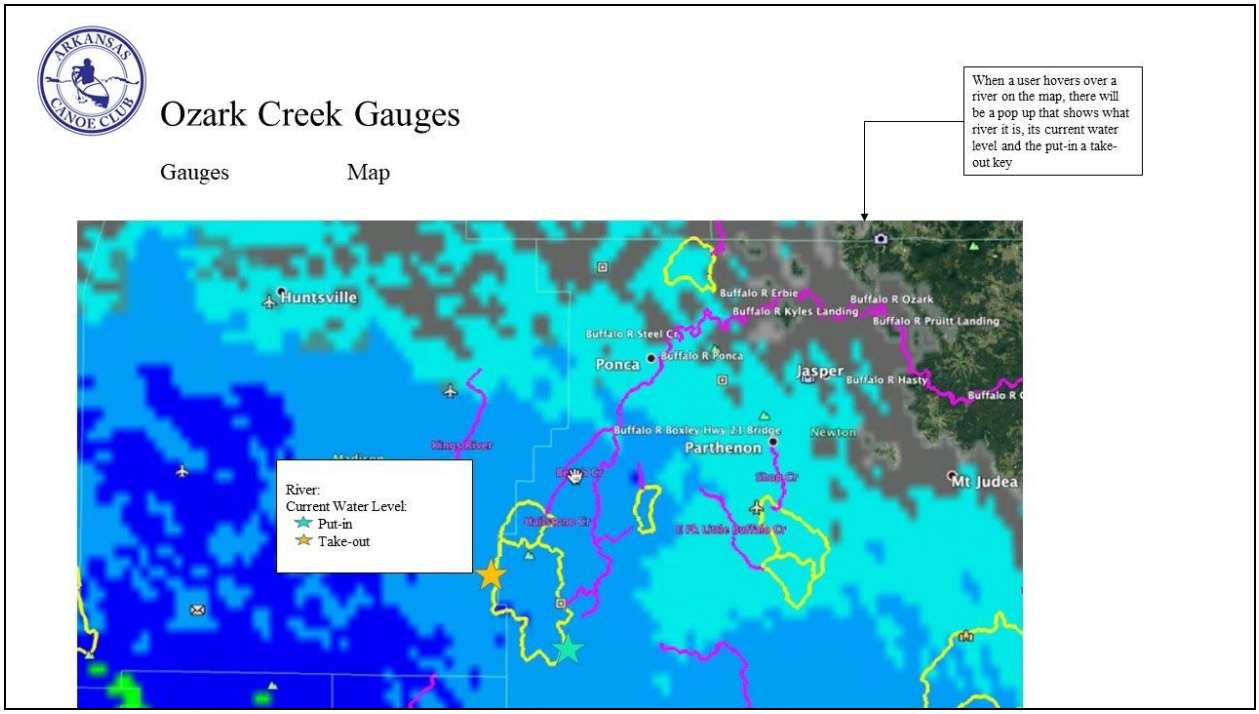
Since the old page is not formatted like a modern website, we will be adding a title and tab names at the top of each of the pages. Creating the home page will require us to use a Python-Perl plugin so we can write Python inside the Perl code. This is so we are able to pull from the original Perl from the working site, and be able to implement new functions to make it work with our redesign vision and new Web Framework. We will do this by making the table with the river information more concise and organized; this will include updating the safe water levels to make sure that new users have the most up-to-date information. We will also create a new key that will be more digestible for inexperienced boaters or users new to the site. The key will be on the side of the river table and will scroll down will the user so they can easily use it while also looking at the table.



<u>Redesigned Home Page</u> - we will just be updating what is currently on the website to have a modern look so it is more readable and updated with current information.

The new river map page will be the bulk of our work for this project. This is something that would be a brand new aspect to the site. For this page, we will be implementing Google Maps onto the page where there will be polygons of the river streamlines that are included in the gauge table. On the map, when a user hovers over one of the river polygons there will be a pop up that shows what river it is, its current water level, and a key for the markers. Which will display its put-ins, take-outs, and rapids. This will allow users to be able to easily find out information about the rivers that go beyond just the water gauges. We hope to have an option where users can input information that is not currently on the site to keep it fresh. Users can sketch their own polygons of river streamlines that aren't currently available on the map and insert markers.

Our team has spoken to the original programmer for the site, Bill Herring, who first made this code. He is a whitewater kayaker and wanted to have a website where he and fellow paddlers could look at all the different creeks and rivers in the area without looking up all of them one at a time on the USGS website. Herring shared that he has long wanted to update the website but had not found the time to do so. He did start gathering polygons on Google Maps and has overlapped rainfall data.



New River Map Page - Implementing Google Maps onto the page where there will be polygons of the river streamlines that are included in the gauge table. There will be a pop up that shows what river it is, its current water level and a key for the markers. Which will display its put-ins, take-outs, and rapids.

4.3 Risks

Risk	Risk Reduction
Outdated info can be dangerous	Flag any stream that has experienced intense rainfall within the past two weeks.
Trespassing	Create a tag that users can check before creating a new "put-in." Then when users look for new streams to use they can filter those that are on private property.
Readability/Comprehension	Ideally, beginners should be able to digest the content of the site without issue. Thus, a complete redesign of the layout by people with no experience in paddling (i.e. the team) may be beneficial.
Site Reliability	Outside of the layout changes, the majority of the original code should be left alone as it has run for over

	20 years with minimal maintenance. We would like to maintain this integrity by writing the new functions in Python and call these scripts from the Perl code.

4.4 Tasks –

1. Research
    a. Water levels that are good for recreational paddling
    b. How to integrate Google Earth into website
    c. Web framework that we can use to design website
2. Create Final Report / Team Website
3. Retrieve starter code
    a. Get Perl code for the Ozark Creek Gauge website
    b. Google Earth - Rivers and creeks layered onto maps (from Bill Herring)
4. Create database for water trends
5. Redesign Website formatting
6. Implement Website Design
    a. Initial page of the gauges (emphasis on readability)
    b. Mapping interface
7. Design Google Earth interface
8. Integrate Google Earth
    a. Allow a user to "sketch" put-ins, take-outs, rapid markers, river/section labels on the map.
    b. Allow a user to sketch the path for each river/section on the map.
    c. Allow a user to sketch the watershed polygon for each river/section on the map.
    d. Combine NWS rainfall estimate data with the user's data on the map.
    e. Combine USGS gauge level data on the map.
9. Final presentation

4.5 Schedule –

Tasks	Dates
1. Research	11/16-11/30
2. Final Report/Team Website	11/16-12/10
3. Retrieve and review starter code	1/13-1/22

4. Create database for water trends	1/23-2/10
5. Redesign Website formatting	2/10-2/24
6. Implement Website Design	2/24-3/10
7. Design Google Earth Interface	3/10-3/24
8. Integrate Google Earth	3/24-4/18
9. Final presentation/Documentation	4/19-4/29

4.6 Deliverables –

- Design Document: Contains diagrams of Website and Google Earth pages
- Database scheme and initial data: The DB schema is for a MySQL Database
- Website code: The Perl/Python code for the website
- Final Report

5.0 Key Personnel

Kruz Higginbotham – Higginbotham is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. She has completed Software Engineering which has given experience in developing projects, completing sprints, and working together with a group.

Karen Alas – Alas is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. She has completed relevant coursework in Software Engineering and Database Management Systems. This has given her experience designing a website and implementing a database using SQL.

Mira Cary – Cary is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. She has completed the Software Engineering class where she had to implement a website with a database which will be relevant for this project. She worked as an IT intern in summer 2018 for Baldwin & Shell Inc. and has been the eCommerce intern since May 2020 at 5G Consulting.

Morgan Maness – Maness is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. She has completed programming paradigms, which has allowed her to get a grasp of how to create and edit web pages, database management systems which has taught her how to create databases, as well as numerous environmental science classes which allows her to understand the terminology for what they are implementing.

Dakota Dale – Dale is a senior Computer Science major in the Computer Science and Computer Engineering Department at the University of Arkansas. He has completed coursework in Computer Graphics, Big Data and Software Engineering. He also performs research that uses machine learning to map out crop fields. This gives him experience in different mapping technologies like ArcGIS and Python libraries like Rasterio.

Bill Herring – Herring has been in software development for 30 years and currently works at Alight Analytics in Kansas City as Director of Software Development. He created the Ozark Creek Gauges Page while in school at the University of Arkansas in 1992, developing a CGI Perl application that is used by tens of thousands of whitewater paddling enthusiasts to gauge and predict river levels around the Ozarks. He is an avid whitewater paddler and has served in leadership roles in the Arkansas Canoe Club. He has taught kayaking skills to scores of beginning paddlers and has coordinated projects with the USGS over the years to increase access to whitewater sports data and visualizations.

6.0 References

[1] Paddle Wisconsin, https://www.arcgis.com/apps/webappviewer/index.html?id=97c40a1f09484fc580057fa2767fd63a&extent=-11199294.2839%2C5006465.504%2C-8851148.775%2C6103489.734%2C102100

[2] Ozark Creek Gauge Website, http://www.ozarkpages.com/cgi-bin/stages.pl?ST=level