09-24-2022

Project Plan

30 Field Day

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Project Description

Overview (ABET-2):

Field Day is a set of wildlife data collection and query tools designed to mitigate errors in data collected through the capture-mark-recapture (CMR) process. Field Day consists of a data collection and access tools such as a PWA, a database, as well as supporting documentation. Currently, the application and database are only used by Dr. Bateman and wildlife students. Dr. Bateman would like the application to be designed in such a way that it can be adapted to different projects in the future. Potential users could be state and federal natural resource employees and members of non-profit organizations. Dr. Bateman also mentioned medical doctors and researchers. The application should be designed to accommodate potential users across many diverse fields of study. Any professional that needs to collect and query data in the field should be able to adapt this application to suit their needs.

GLOBAL TRENDS (EM@FSE-e)

Field Day is an academic research tool for wildlife students at ASU. The focus of Field Day is to simplify the process of collecting and querying data in a way that also reduces errors. Created by software engineering students, it also serves as practice with interdisciplinary work. Software students learn to understand and meet the needs of clients outside their own domain.

MARKET ANALYSIS (EM@FSE-k)

Previously, data collected during CMR research was recorded on handwritten data sheets and sometimes digital spreadsheets. These methods are prone to error and require extensive double-checking of all entered data. Field Day will save time and reduce errors by having the data entered digitally and stored directly in a remote database. This technology was tested over a 2 month period in 2013 and it was “estimated that using the mobile application instead of manual data entry and proofing via data sheets reduced the total project time by 10%.” [1]

SECURITY CONSIDERATIONS (SER-2)

The database does not need to be encrypted, but it needs to be secure. It should be password protected to prevent unauthorized access. If security is breached, collected data could have its integrity compromised or be lost entirely. The system should be designed in such a way that the client can be connected to a new server if the original server is rendered unusable for any reason. A backup of the database should be maintained at all times.

[1] Mobile Application for Wildlife Capture-Mark-Recapture Data Collection and Query by Bateman, Lindquist, Whitehouse, and Gonzalez

Key Requirements (SER-2):

Data Collection and Access Tool (PWA)

- The final application must be cross-platform and work on iOS, Android, Web.
- The user must be able to enter data using pre-programmed controls (text fields, checkboxes, dropdown menus, keyboard entry, etc.).
- The application must include features to ensure the collection of all measurements in the field.
- Pop-up messages should be displayed to warn the user of incomplete data.
- The application should verify the format of entered data.
- The application must connect to a remote database.
- The user should be able to query the database in the field to view the histories of previously captured animals.
- The application should store field-entered data on the device and sync to the online database when possible.
- The application should be open source and built in such a way that it can be repurposed for other fields of study.
- The application must be able to display and query data from the field without a wifi signal and then sync data with the database when a connection is available.
- The application should be responsive and have a clean appearance and intuitive UI regardless of the device used to access it.
- The application should display a pop-up error message indicating data could not be uploaded upon encountering an error server-side.

Database

- The database must be as cheap as possible.
    - Dr. Bateman currently pays $16 per month out of her own pocket.
    - It is currently hosted on AWS.
- The database must be secure and password protected.

Documentation

- The application must be delivered with a user manual that is readable by a biologist
    - The user manual must be reviewed by Dr. Bateman before it is finalized.

Deliverables (SER-1):

Firstly, the project will create a progressive web application that is able to run offline and aids in the collection of wildlife data in the field. It will be password protected, and will sync with the database upon established internet connection and user request. Next, another deliverable will be the database hosting software that keeps track of the wildlife data. It will be secure, fault tolerant, and available 24/7. Finally, the server will handle user requests and will query the database. Another deliverable will be a guide for showing the average user how to navigate the application.

Acronyms and abbreviations (ABET-3):

Terms		**Definitions**
API	Application Programming Interface	An API is an intermediary that allows more than one computer application to communicate with one another.
AWS	Amazon Web Services	AWS is a commonly used cloud platform. Currently the Field Day application and database are hosted on AWS.
CMR	Capture-Mark-Recapture	CMR is a survey technique where researchers capture members of a certain animal population, record relevant data, tag them, and release them back into the wild for later recapture. This technique is often used to estimate the size of a population.
MVC	Model View Controller	An architectural pattern common for UI design. It consists of three elements: the model represents program data independent of the UI, the view is one possible visual representation of this data, and the controller receives commands from the UI and maps them to the appropriate actions on the model.
PWA	Progressive web application.	PWAs are applications for the web that simulate a native experience and can be installed for offline use.
JS	Javascript	Javascript is a programming language that is widely used for web development. It allows websites to be dynamic and interactive. It will be the primary language used in the Field Day application.
UI	User Interface	UI refers to the parts of an application that the user interacts with.
UX	User Experience	The user experience is how a user interacts with and experiences a product, system or service. It includes a person's perceptions of utility, ease of use, and efficiency.

Design and Architecture

Design Description (ABET-1, ABET-2)

This is the chosen design that the team will implement the project.

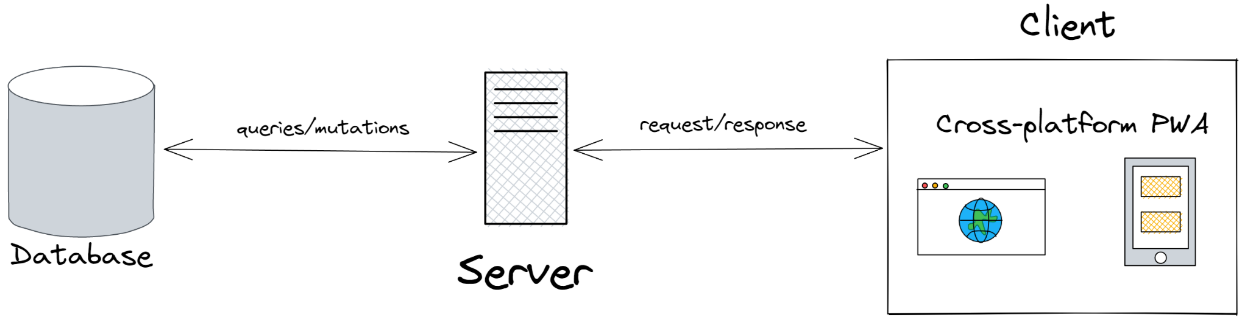


Figure: chosen design; client, server, and database architecture diagram, at the abstraction level of components.

- Database
  This component will handle the storage and organization of the user data, and will respond to the queries/mutations sent from the server with the appropriate operations. Exact database is still to be determined, but a likely candidate is running a cloud provider such as Planetscale, which runs MySQL on AWS under the hood, and uses Vitess for scalability, and using Prisma as the ORM between server and database.
- Server
  This component will handle the requests from the client and will send responses to the client with the appropriate data. It will also send the queries/mutations to the database. Additionally, it will verify user authentication.
- Client
  This component will handle the presentation of data to the client, as well as the sending of requests and the receiving of responses from the server.
- Design Patterns
  One possible design pattern is Model-View-Controller (MVC), or one of its variants. In this architecture, the Database will be the Model, the Server will be the Controller, and the Client will be the View.

Alternate Design Possibilities (EM@FSE-b)

The following designs were considered and discarded as alternatives.

The first alternative was considered due to its simplicity, but ultimately was discarded due to the monetary constraints and the lack of freedom in implementation details.

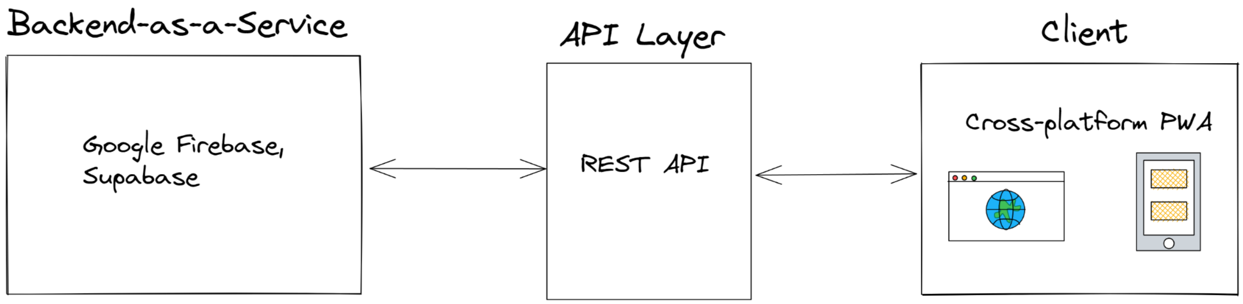


Figure: Design Alternative 1

The second alternative was also considered due to its simplicity, but was discarded because it only works on one device, and the requirements specify that this should work across an entire team.

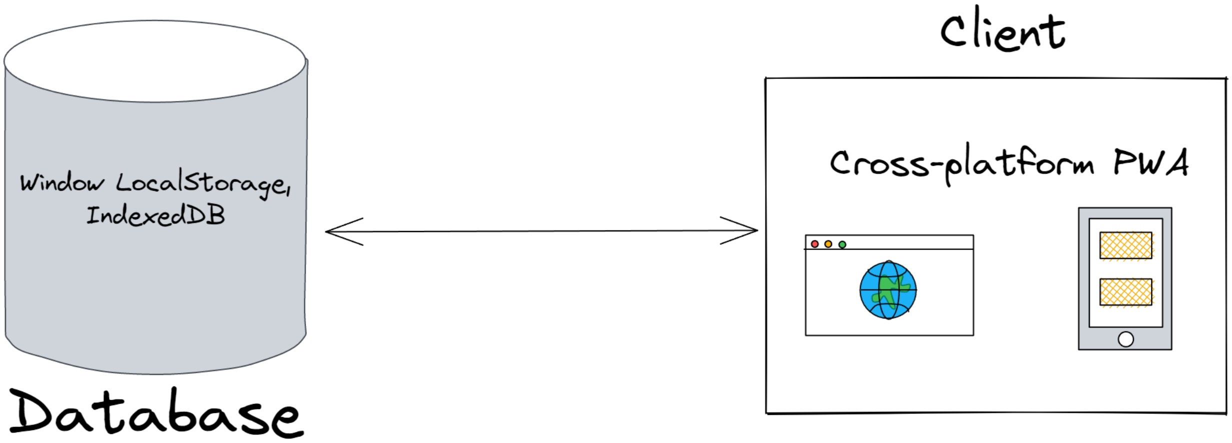
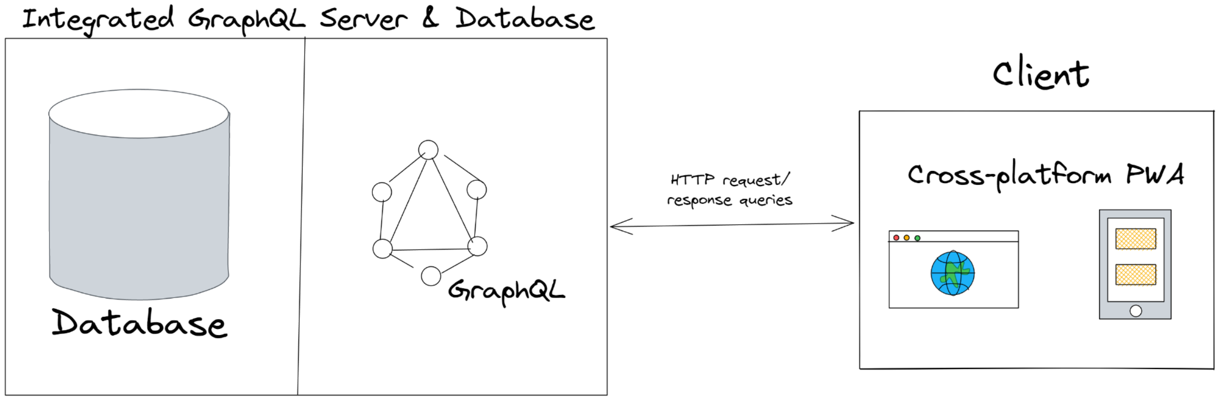


Figure: Design Alternative 2

The third alternative was considered due to its security and scalability, but was discarded due to GraphQL technology not being appropriate for the type data that the sponsor wants to store.



src: https://www.tutorialspoint.com/graphql/graphql_quick_guide.htm

Figure: Design Alternative 3

After researching various designs, the development team considered the importance of various criteria that goes into a design, and ultimately reached a conclusion.

Factors	Security	Usability	Speed	Cost	Total
Weights	3	4	4	5	
Chosen Design	4	5	4	5	73
Alternative 1	4	4	3	2	50
Alternative 2	2	4	5	4	62
Alternative 3	3	4	3	3	52

Figure: Design Decision Matrix

Implementation Strategy

High-level Work Breakdown Structure (SER-1):

For the progressive web app, the team will need to instantiate a full stack javascript framework like Next.js, create a manifest, service worker, and fulfill any other requirements to pass Google's lighthouse test to be a fully fledged PWA. Then, the team will need to create the required pages, components, and other UI elements for the user to interact with the application. Next, the team will need to deploy the app to a hosting service such as Vercel, passing the testing suite needed for Vercel to successfully deploy an application. The skill set required for this task includes front-end web development knowledge such as CSS styling, component reusability practices, rendering knowledge, and all other aspects of client-side web development. Expected time required to complete this task is 1 sprint or 4 weeks. For the database, the team will need to create an account with a database hosting software, instantiate the database, select a payment plan, then save the database credentials for connecting to the backend later on. The skill set required for this task includes database development and implementation knowledge, as well as integration knowledge. Expected time required to complete this task is estimated to be 1 user story or 2 weeks. For the backend/server, the team will need to populate the routes in Next.js, as well as implement the database query logic and the API layer to interface with the client. Skill set required includes backend knowledge of implementing routing and API, as well as database queries and mutations. The estimated time of completion is 1 sprint or 4 weeks.

Schedule / Timeline (SER-1):

The first overall milestone will be the front-end UI layer, finished near the end of the first semester or at the beginning of the second semester. During the first milestone, UI prototypes will be created to gather input from the sponsor to determine the best design to follow. During the break, the team will be refining the frontend. The next milestone will be the backend layer, including the database, and that will be done towards the end of the second semester. This also includes incorporation of front and backend so that the entire system works together. During this milestone, the sponsor will have access to the production version of the project to give their input to the team as to how they should proceed with implementation. For the first part of the first semester, the team will conduct research and training for the application domain.

Required Hardware (SER-1, EM@FSE-o):

Hardware required for the development of the project includes the team members' iPhones, Androids, and personal development computers. No other hardware is necessary.

Third party content (SER-1, EM@FSE-o):

Third party content required for the project includes hosting software such as Vercel and database software such as Planetscale. Both offer a free license for small, non-commercial projects such as this one.

Quality (SER-2):

The UI should be intuitive and visually appealing, and should follow UX laws and guidelines to support the usability goal. The UI should respond to user interaction within 500 ms, and the PWA should load in under 2500 ms to support the performance goal. For the reliability goal, the database should be available 24/7, and should be fault tolerant. For functionality, the application should satisfy all customer requirements. For supportability, the software should work on any device that supports a web browser, should scale appropriately as the user base grows, and should be adaptable to changing requirements in the future.

As for language and coding styles to support readability, the team will use the Prettier VS Code plugin to define coding standards, and these will include a 4-space tab width, a blank new line character at the end of each file, and the recommended coding styles that come with the prettier plugin. In addition, the team will make adjustments as needed to adhere to DRY (do not repeat) principles to maintain reusability and maintainability, so that the code can be easily comprehended and adapted by future software teams for other application domains.

References/Sources of Information (EM@FSE-q)

One such area of research is web development as a whole, both client-side and server-side. This is important because PWAs are fundamentally built on the web and are an extension of it, thus an extensive knowledge of how the web works is required. Quality references for this area include w3 schools, geeks for geeks, and web.dev. Another area of research is PWAs, or progressive web apps. This is important because this is the fundamental technology on which the application is built. Quality references for this area include mdn web docs, web.dev (PWA), and microsoft.

Scalability (EM@FSE-J)

The database layer will be built on MySQL, and can scale to 5gb, 1 billion row reads per month, and 10 million row writes per month, on the free tier. After that, the next tier starts at $30 per month, and includes 10gb storage, 100 billion row reads per month, and 50 million row writes per month. Vercel, the platform which is in charge of hosting, is offering at the free tier: 100 artifact requests per minute, 500 domain retrievals per minute, 100gb bandwidth per month, and 100 gb-hours of serverless function execution per month. After that, Vercel charges based on usage. Bandwidth can be limited by utilizing the cache on each user's device.

Other Special considerations (ABET-2):

No special considerations apply.

Process

Process Description and justification (SER-1)

The development team will be using the agile development methodology. They will adapt agile development through the scrum framework. Rather than scheduled standups on a voice call, the development team will use a slack channel (field-day-2022-standup) to answer the standup questions (1. What you got done since the last meeting; 2. What you're going to do before the next meeting; 3. Any obstacles in your way). The status of the tasks will be tracked via a GitHub project. By using GitHub's project feature, the development team can easily associate tasks with branches. The development team will also be using ZenHub to track the user stories, sprints, backlog items, and all other aspects of scrum. An agile development strategy will help meet the requirements from the sponsor by being able to demonstrate new features as soon as they're developed, giving the sponsor plenty of time to give the development team feedback.

Tools (SEr-1, EM@FSE-O):

Beyond the hardware of the computers the development team will be developing on and the phones being used to test the project with, a cloud database service will be needed. The development team is currently negotiating with the sponsor what option the development team will use. Initial research has narrowed the potential options down to Planetscale, Amazon RDS, Google Firestore, Vercel, Supabase, and Mongo Atlas.

Roles and Responsibilities (SER-1):

Every team member is expected to attend meetings regularly, but nobody is expected to attend all of them. Openings for meetings occur every morning at 9:00 AM and 6:30 PM Arizona MST. If there is anything to discuss, all members that are currently free will enter a Slack Huddle to discuss it. One purpose of these meetings is to create tasks to add to the GitHub project page. These tasks will be available for all team members to assign to themselves to take on, develop, and submit for review. Once a pull request has been submitted for review, at least two of the other four team members must review the code to reduce bugs and ensure the addition will meet the requirements. All team members will always have the responsibilities of meeting and developing, and will fill in as reviewers on a first-come basis.

Location of Project Artifacts (SER-1):

The development team will manage their work through a GitHub project (github project link) and a ZenHub board (ZenHub link). The project itself is not yet live, but the repository for it can be viewed here. The project will allow tasks to be created to represent features required to run the project and meet the sponsor's requirements. GitHub's layout is very intuitive and easy to use. Keeping assignments on the same site as the repository will help with organization. In addition, the development team will use ZenHub to keep track of the artifacts, such as sprint backlogs and use stories, and each task in ZenHub will have a matching issue in GitHub projects if the task is applicable to code. GitHub rarely has outages, and has only become more reliable since they've completed upgrading their database hardware this past March. For files associated with organization such as this document or any design diagrams, the team is using Google Drive. For one-time file sharing such as asking teammates to solve a minor bug or proofread some text, files can be uploaded to the private Slack group.

Sponsor communications (ABEt-3):

The development team is currently planning to meet with the sponsor as needed at 1PM Arizona MST on any Tuesday or Thursday when there is reason to do so. This can include clarifying requirements, demonstrating features to receive confirmation that they're working as intended, and discussing any changes to the project. The sponsor is currently on sabbatical, so meetings will be sparse, but the development team plans on adhering to the 1PM Tuesday/Thursday slots for potential meetings as needed. These meetings will all be conducted digitally via Slack, as no member of the team is physically present at ASU. All communication with the sponsor will be through a dedicated channel within the slack group. By keeping communication contained to just this channel, the development team can maintain organization.

Risk management

identified Potential risks (SER-2):

Risk ID	Risk Name and Description	Expected Incidence
R-001	Availability of Team Members The development team is distributed geographically with responsibilities outside of school and their schedules rarely align. This risk is chronic and will persist throughout the life of the project. Having to work asynchronously introduces complications to working efficiently but the development team is confident that they can find strategies to mitigate this risk.	Persistent throughout the whole project
R-002	Team Communication Establishing communication is critical for any project. Being a distributed team presents general risk. The development team has seen it manifest early on in the project where communicating asynchronously and piecing together or searching for information can waste time. There are methods the team has learned and tools the team has used to mitigate this issue.	Persistent throughout the whole project
R-003	Sponsor Communication The sponsor is the customer for this project. The communication with the sponsor is the most critical part of the project. The development team is dependent on the sponsor for feedback. The development team needs methods to be able to get their feedback and get updates on the project.	Bi-weekly, depending on sponsor's schedule
R-004	Reliance on Amazon Web Services There's an existing progressive web application (PWA) that Dr. Bateman uses which must be considered in the project. Some of the stated desires by the sponsor include decreasing the cost of maintaining this program. It's an out of pocket cost of $16 every month.	Critical point is after completing research on design
R-005	Design No one in the group has experience with building a progressive web application. This presents risk in the form of a learning curve. The development team expects that the beginning of the project will be affected by this more so than the end of the project.	The development team expects this to have incidents throughout the project, although not persistent
R-006	Technology	This is prevalent at the

	Similar to design, the team is also inexperienced with the technology present in this project. More specifically, the service workers present in a PWA. This falls under the learning curve which is also present with design.	beginning of the project.

MITIGATION STRATEGIES (SER-2):

- Note: One of the main needs from the sponsor is to reduce cost. For this reason, only mitigation strategies that have no cost are discussed.

ID	Risk	Mitigation	Cost
R-001-M	Availability	The development team has established a cadence of daily huddles where members who are available can meet to discuss progress on their assigned tasks. Additionally, establishing a stand up channel in Slack has been established where the team can update their daily activity.	No additional cost
R-002-M	Team comm	The development team is using several different tools with processes learned in the program. These tools include Github Projects, ZenHub, and Slack. Each has benefits to the project. GitHub Projects helps manage tasks integrated with the repos. ZenHub provides metric data so the development team can measure their progress and report to class. Slack allows the development team to communicate asynchronously	No additional cost
R-003-M	Sponsor comm	In order to organize communications with the sponsor, the development team has elected to have a sponsor liaison. This person will be responsible for coordinating and documenting the meeting with a sponsor for the week. It can change from week to week but doesn't have to. This is based on member schedules as well as Bateman's	No additional cost
R-004-M	AWS	The development team has other options that can be used. However, the development team is still learning about the infrastructure of the existing system. The team expects to find another service that can be used, but are in the middle of this mitigation.	No additional cost
R-005-M	Design	The development team knows that it is possible to implement this project. In order to mitigate this risk, they're reverse engineering the existing project	Will add time to project but this is a value add that

		to expand upon the capabilities. The ultimate goal is to create a service that can be utilized by other departments within the university.	cancels out cost
R-006-M	Technology	The team members have taken on the task of researching PWAs and understanding functionality by downloading PWAs of apps they’re familiar with like Instagram, Hulu, and Twitter.	Some additional study time