Ultramarathon Aid Station Management System

http://classwork.engr.oregonstate.edu:3550/

Team: Canvas Group 33: The Runners

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I. Executive Summary

We started this project off with a concrete idea of what we wanted to build. We wanted to create a system for managing aid stations in large marathon style races. Aid station management can quickly get complicated when there are many aid stations for a single race, many volunteers that work at different aid stations, and many different supplies that are stocked at different aid stations.

We created a project outline that listed all the entities that would potentially be involved in the management system, including races, aid stations, volunteers, and supplies. We also anticipated the need for keeping track of which volunteers were assigned to each aid station and what supplies would be stocked at each aid station. We planned to record this information in intersection tables.

In the first step, we received feedback on the consistency of our formatting and naming convention for proposed attributes. We updated our proposed tables and attributes to have a consistent naming convention and we also added the proposed intersection tables to our ERD for a more complete overview of the project scope.

Next, we created a schema based on our ERD using PHP MyAdmin and MySQL Workbench. We included all of our proposed entities and attributes, and the intersection tables that would display aid station volunteer/supply assignments. We also defined relations in this step and their cardinality, such as the M:N relationship between aid stations and volunteers.

As we built out the DDL and DML files for the SQL required to create our database schema and populate it with sample data, we received feedback on the format we were using for inputting dates. We researched best practices in the MySQL documentation and updated our formatting to match. We also revised the structure of our SQL to be more clear.

We created a user interface built on React and Express to interface with our database in an intuitive way. We made separate pages for all entities and included forms for CREATE and UPDATE operations, while having buttons for DELETE operations. Each page employed READ functionality by querying the database for the sample data for the relevant entity. We received feedback on the visual styling of the interface, and updated it to make sure it was as clear and intuitive as possible.

We then created procedural SQL functions that could reset our database back to its original state containing sample data, and implement CRUD functionality without having to pass SQL over the network from the backend to the database. In these final phases of the project, we mainly got feedback on functionality that was not yet functional in our UI.

Finally, incorporating all the feedback we received and testing all of the functionality we proposed to implement, we published our interface with a live connection to our database on the classwork server at the URL provided above. While the core structure of our project stayed the same from start to finish, we iteratively improved upon the application at each step, incorporating peer/instructor feedback from each major step, and added new functionality based on what we learned in the course.

II. Project Outline

Over the past several decades, ultramarathons, defined as a footrace any distance longer than a traditional marathon's 26.2 miles, have experienced explosive growth worldwide, including in the United States. In the year 2001, it is estimated that there were fewer than 300 such races in the US; today there are over 2000. Unlike traditional marathons, most ultra distance race courses are situated on trails and often involve technical terrain at high elevation. For instance, the Hardrock 100 is regarded as one of the most demanding races in the United States. It is over 100 miles in length, at an average elevation of 11,000 feet. While the Hardrock field is limited to around 150 entrants, South Africa's Comrades Marathon (approximately 55 miles, despite its title of Marathon) is known as the oldest and largest ultradistance race in the world, with over 10,000 runners.

As the sport grows in popularity, races of various sizes, difficulties and differences between the above extremes are introduced regularly. Due to the unique demands of these events, their aid stations are essential both to participant enjoyment and safety. At a well organized event, these regular checkpoints along a given race's route typically provide services beyond those of a traditional road race, which may have some water, sports drinks, and basic first aid capability. By contrast, large ultramarathon aid stations often include many varieties of solid food, more significant medical capabilities, sports massage stations, ice management (for warm weather races), and even entertainment, each staffed by potentially dozens of volunteers.

This project proposes a database driven website that will allow race organizers to manage the robust logistics network required to produce a safe, enjoyable, and successful event by maintaining relevant data for *Races*, and their respective *Aid Stations*, as well as the *Volunteers* and *Supplies* at each of these.

III. Database Outline

The database driven backend will use the following entities, at a minimum:

- **Races**: records the details of individual races (An individual race director may organize several events. Some events have multiple distance options.)
  - raceID: INT, auto_increment, unique, not NULL, PK
  - name: VARCHAR, not NULL
  - date: DATE, not NULL
  - distance: INT, not NULL
  - type: ENUM ('road', 'trail')
  - Relationships:
    - 1:M relationship between *AidStations,* with raceID as FK inside of *AidStations*

- **AidStations**: records details of individual aid stations for a given race.
  - stationID: INT, auto_increment, unique, not NULL, PK
  - raceID: INT, not NULL, FK
  - name: VARCHAR, not NULL
  - mileMarker: DECIMAL(6)
  - elevation: DECIMAL(6)
  - latitude: DECIMAL(6)
  - longitude: DECIMAL (6)
  - Relationships:
    - M:N relationship between *Volunteers*
    - M:N relationship between *Supplies*

- **Volunteers**: records details of volunteers who staff each aid station.
  - volunteerID: int, auto_increment, unique, not NULL, PK
  - fname: VARCHAR(50), not NULL
  - lname: VARCHAR(50), not NULL
  - email: VARCHAR(50)
  - phone: VARCHAR(20)
  - role: varchar(50)
  - Relationships:
    - M:N relationship between *AidStations*

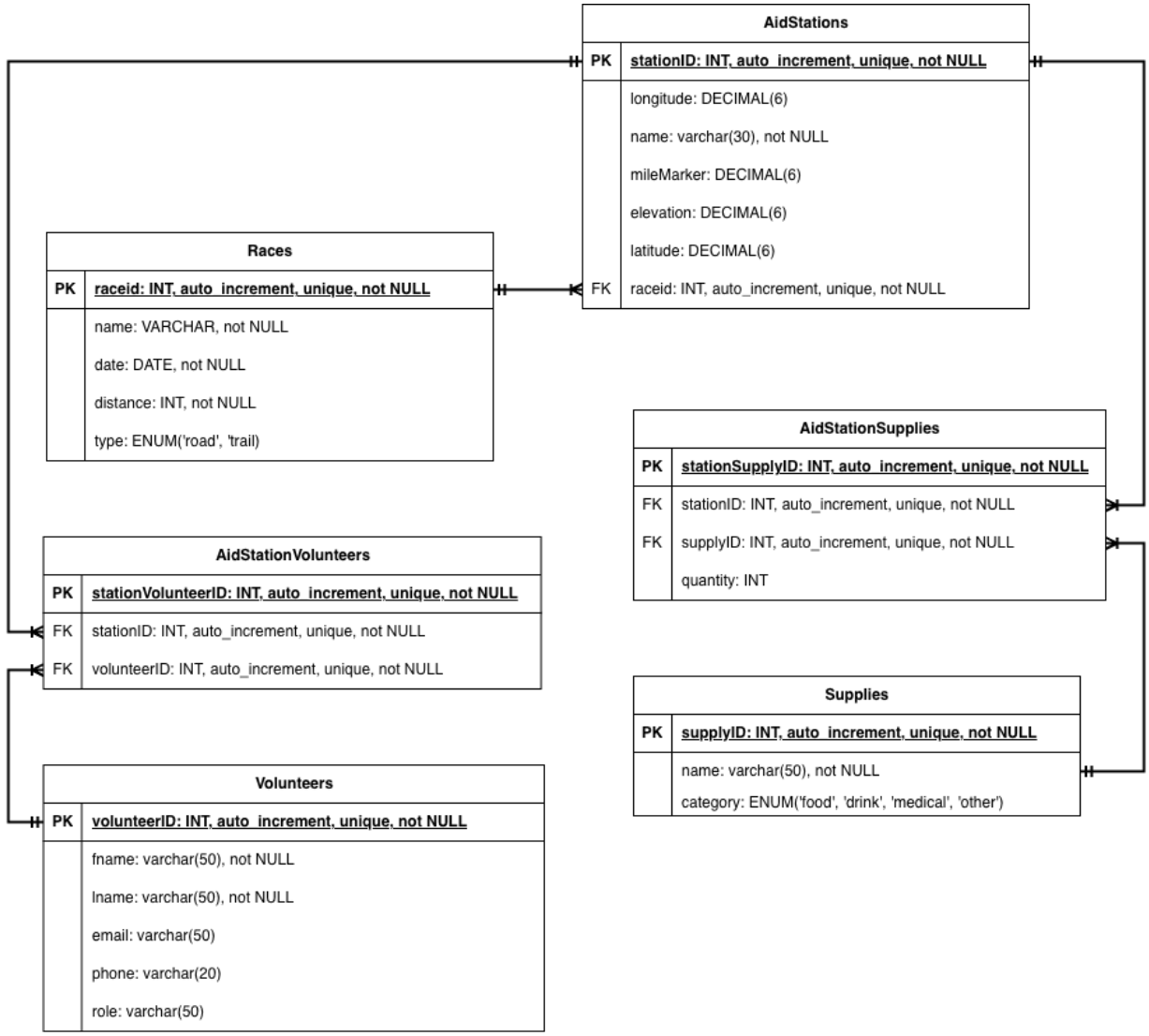
- **Supplies**: records details of supplies used at each aid station.
  - supplyID: INT, auto_increment, unique, not NULL, PK
  - name: VARCHAR, not NULL
  - category: ENUM('food', 'drink', 'medical', 'other')
  - Relationships:
    - M:N relationship between *AidStations*

- **AidStationVolunteers**: Intersection table supporting M:N relationship between Aid Stations and Volunteers.
  - stationVolunteerID: INT, auto_increment, unique, not NULL, PK
  - stationID: INT, not NULL, FK
  - volunteerID: INT, not NULL, FK
  - Relationships: Aid Stations and Volunteers have 1:M relationship to this intersection table to facilitate their M:N relationship

- **AidStationSupplies**: Intersection table supporting M:N relationship between Aid Stations and Supplies.
  - stationSupplyID: INT, auto_increment, unique, not NULL, PK
  - stationID: INT, not NULL, FK
  - supplyID: INT, not NULL, FK
  - quantity: INT
  - Relationships: Aid Stations and Supplies have 1:M relationship to this intersection table to facilitate their M:N relationship

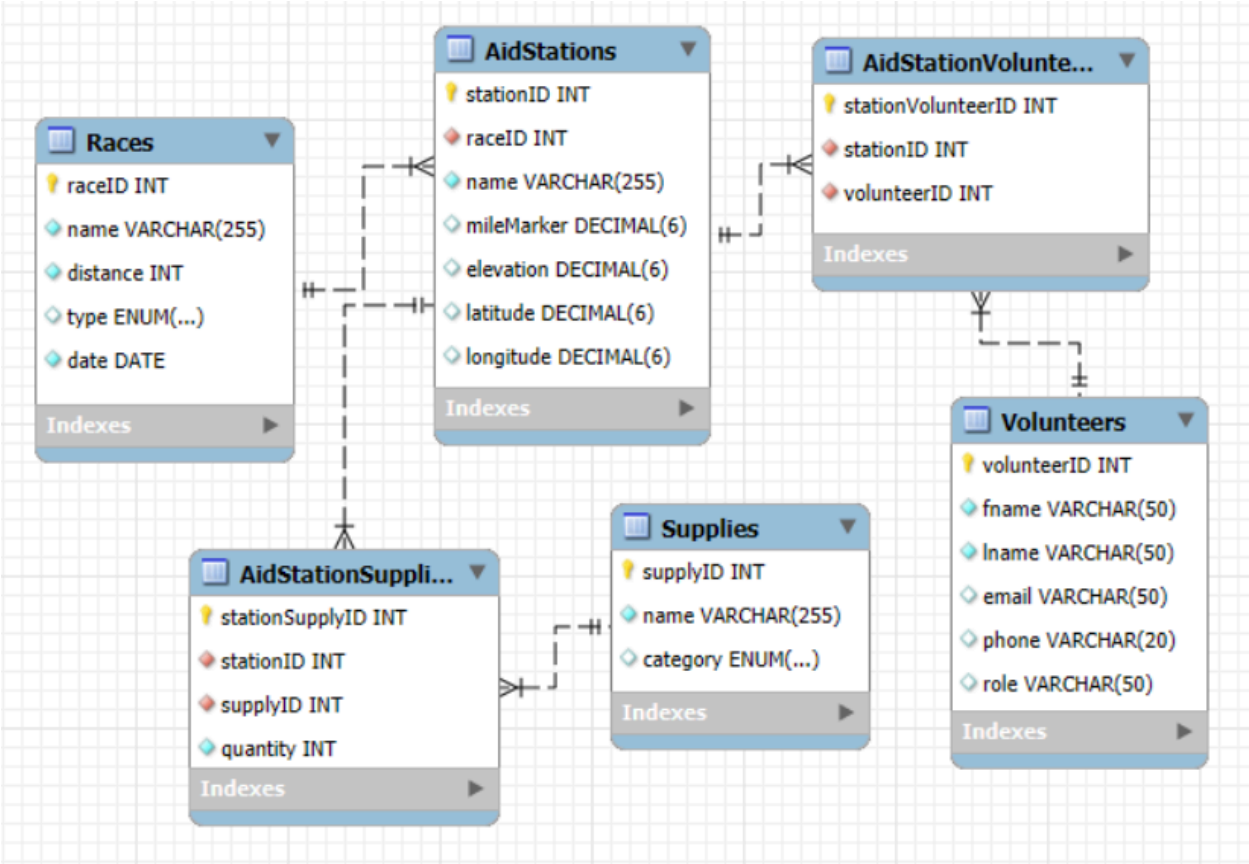
IV. ERD

We created a detailed ERD that includes all attributes and intersection tables. We recognize that this level of detail is not required for an ERD, but would be included in the Schema Diagram.



V. Schema

This is the detailed schema that shows all the entities, attributes, intersection tables, relations, and cardinality of relations.



VI. Sample Data

These are the tables we created as a part of generating a sample report of our database.

Races				
raceID	name	date	distance	type
1	Over The Hills	2024-12-12	12	trail
2	Country Cross	2020-10-10	52	road
3	Ultra Run	2026-03-03	146	road

AidStations						
stationID	raceID	name	mileMarker	elevation	latitude	longitude
1	2	The Hub	3	1000	22	123
2	2	Free Candy	36	324	45	-180
3	3	Gatorade Pool	100	6523	90	45

Volunteers					
volunteerId	fname	lname	email	phone	role
1	James	Humphrey	james@wow.com	111-111-1111	janitor
2	Donald	Duck	donald@wow.com	222-222-2222	bottle filler
3	Toby	Johnson	toby@wow.com	333-333-3333	cheerleader

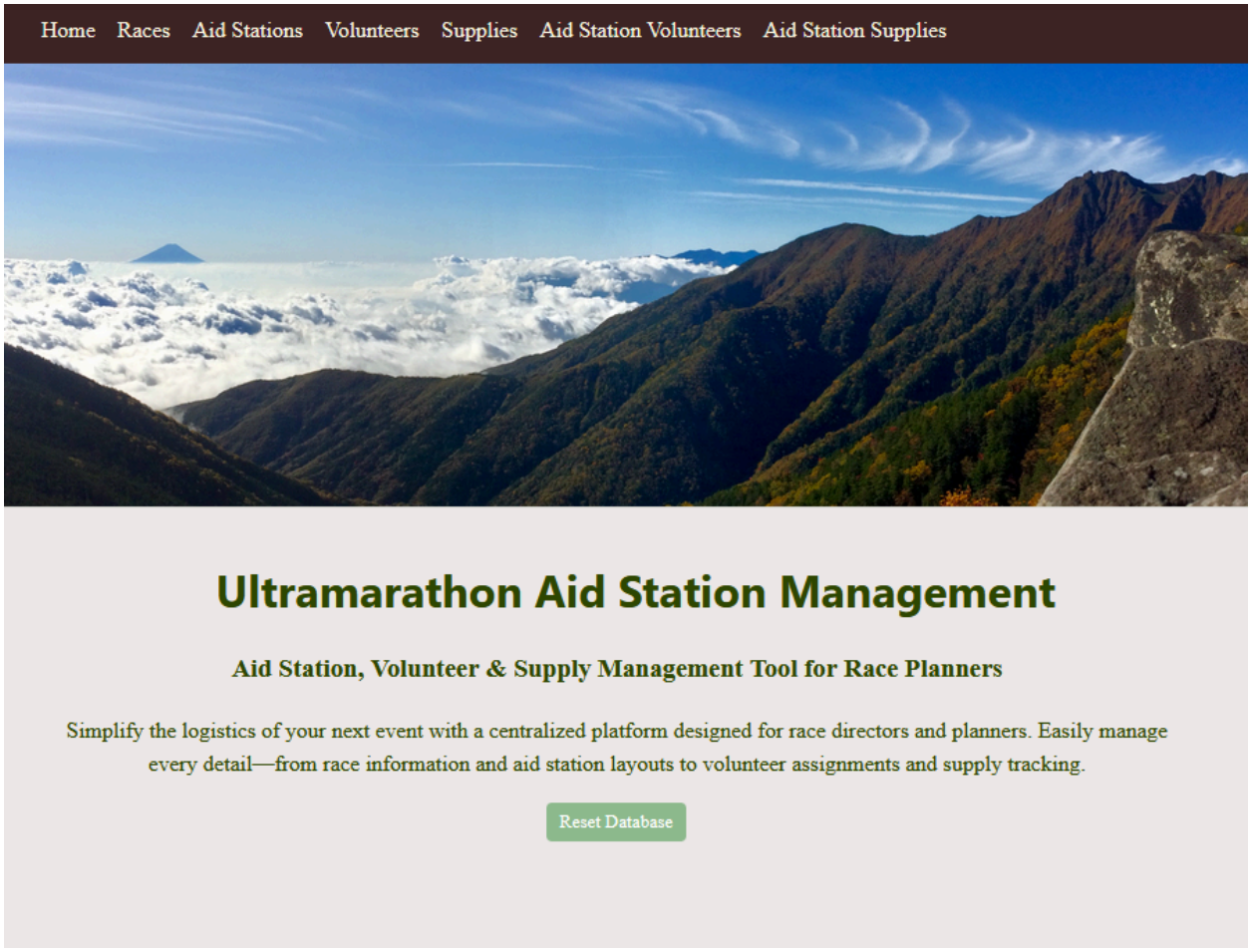
Supplies		
supplyID	name	category
1	Gatorade	drink
2	Protein Bar	food
3	Ice Pack	medical

AidStationVolunteers		
stationVolunteerID	stationID	volunteerID
1	2	1
2	2	2
3	3	3

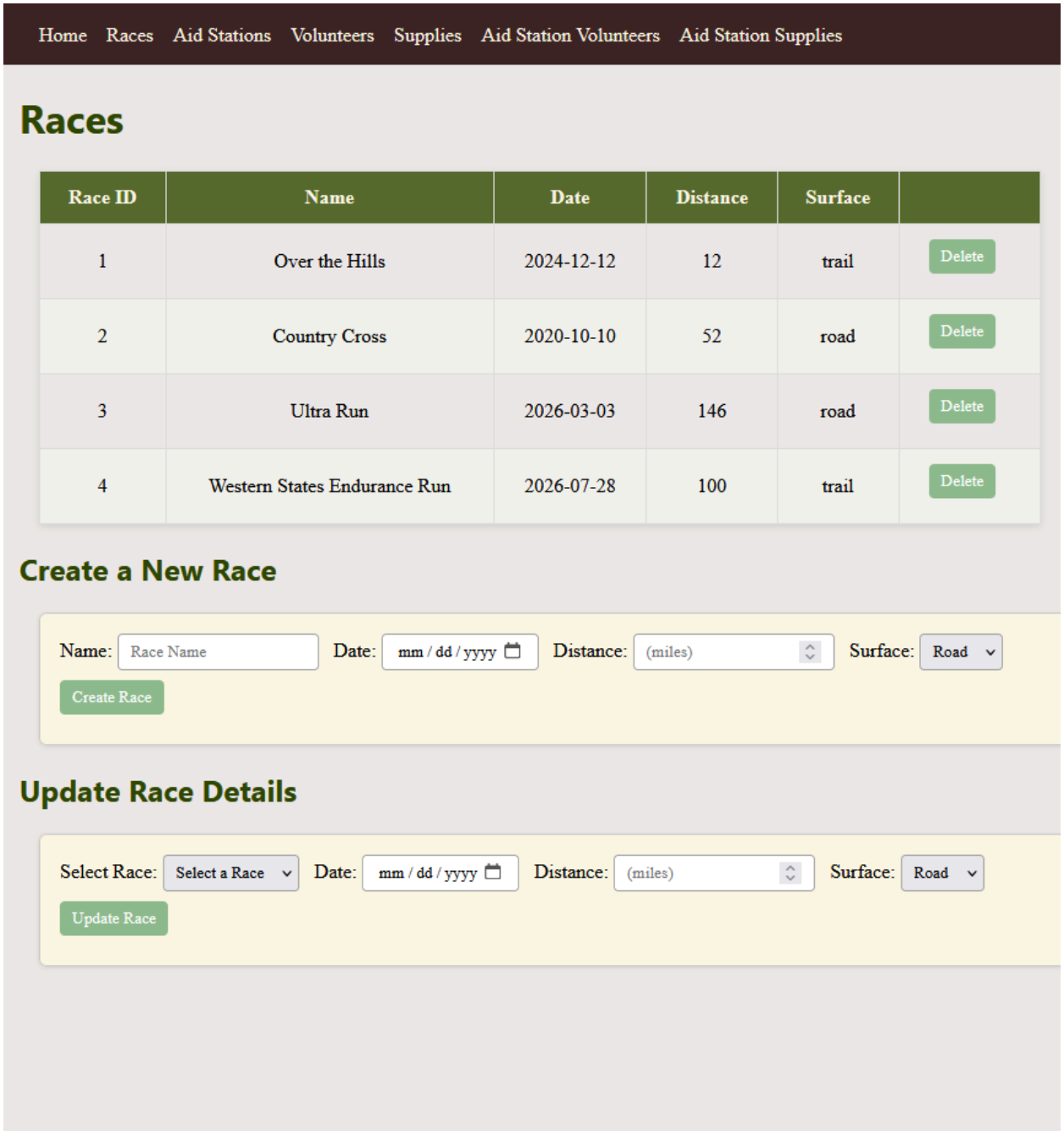
AidStationSupplies			
stationSupplyID	stationID	supplyID	quantity
1	1	3	100
2	1	2	12
3	3	2	5435

VII. Implementation Screen Captures

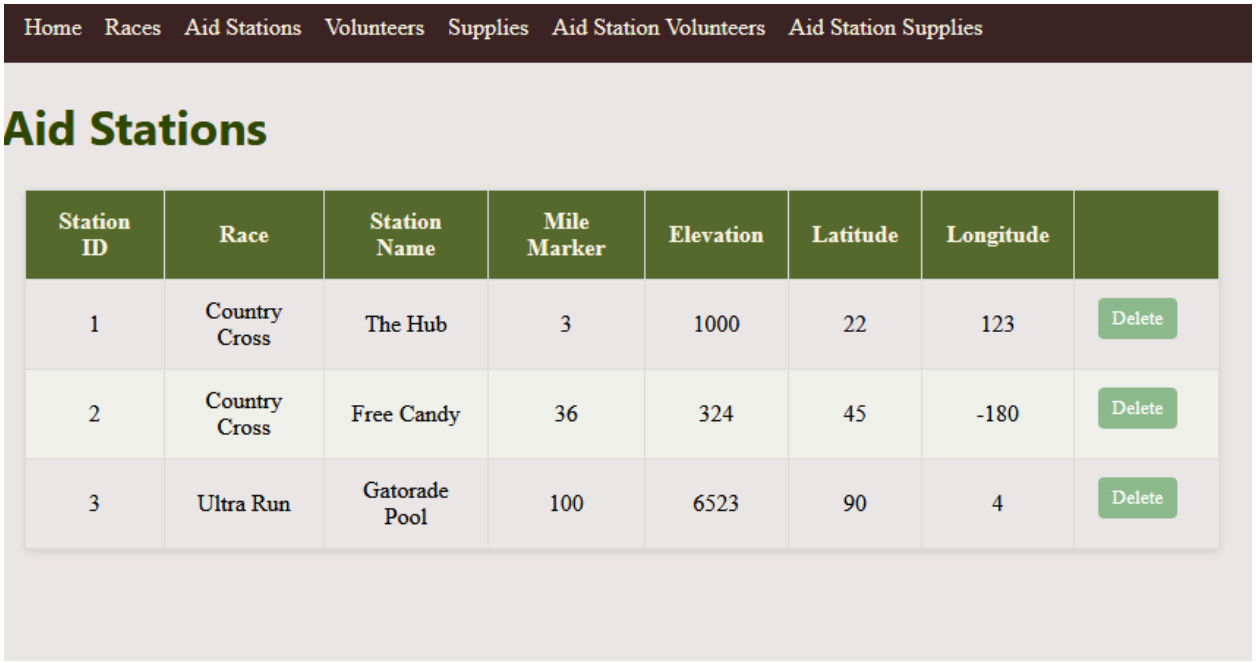
Home Page: Includes **RESET DB** implemented as “Reset Database” Button



Races Page: Includes **READ / CREATE / UPDATE / DELETE** functionality through the Races table, “Create a New Race” form, “Update Race Details” form, and “Delete” buttons next to each race.



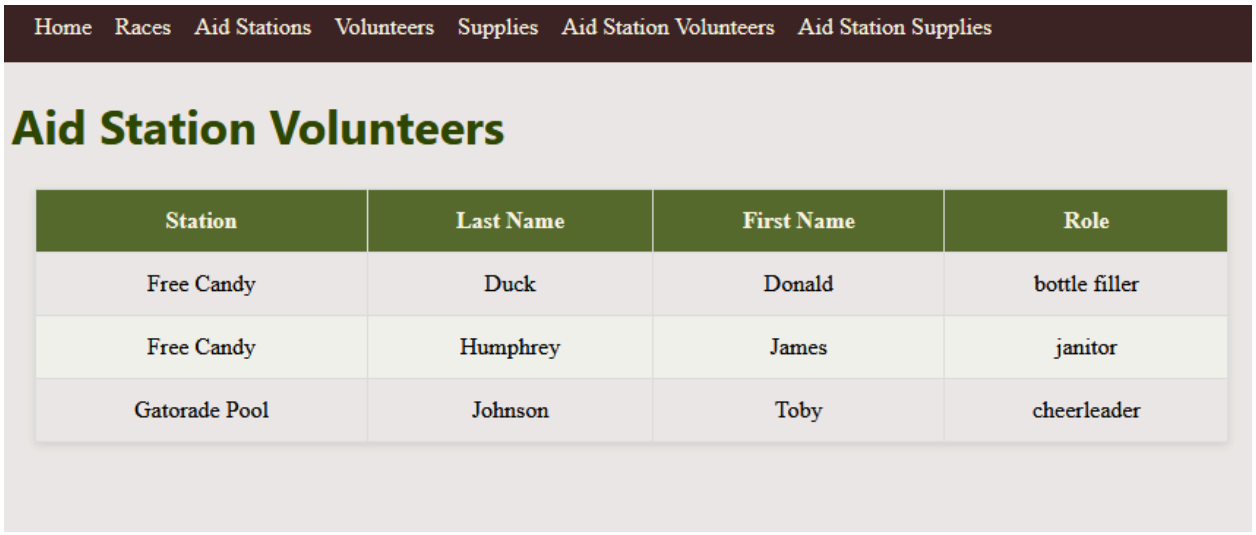
Aid Stations Page: Includes **READ / DELETE** functionality for Aid Stations



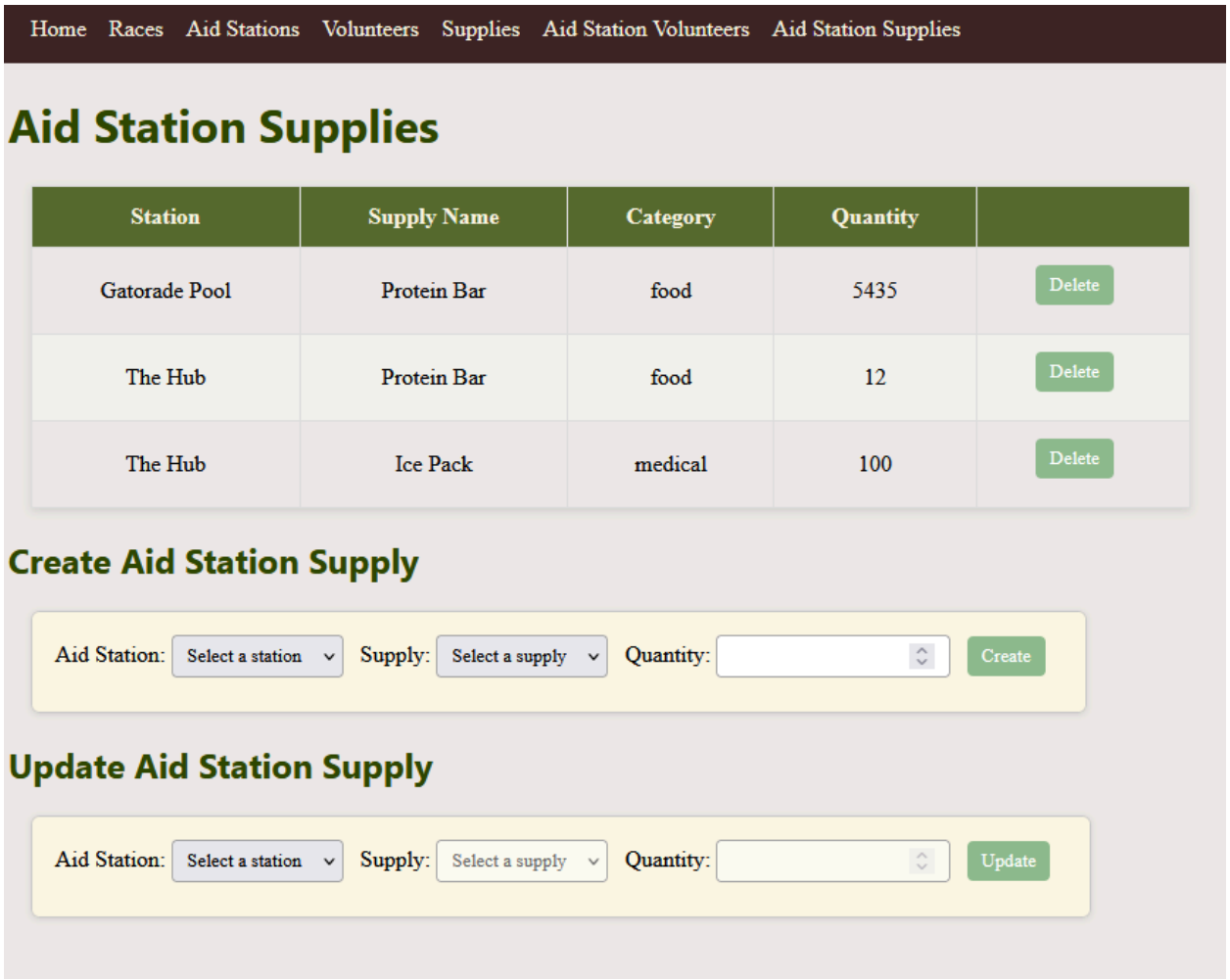
Volunteers Page: Includes **READ / DELETE** functionality for Volunteers.

Supplies Page: Includes **READ / DELETE** functionality for Supplies.

Aid Station Volunteers Page: **READ** functionality for Aid Station Volunteers Assignments



Aid Station Supplies Page: Includes **READ / CREATE M:N / UPDATE M:N / DELETE M:N** functionality for Aid Station Supply Assignments.



VIII. Citations

1. Hardrock Hundred Mile Endurance Run. (n.d.). In *Wikipedia*. Retrieved from https://en.wikipedia.org/wiki/Hardrock_Hundred_Mile_Endurance_Run
2. Comrades Marathon. (n.d.). In *Wikipedia*. Retrieved from https://en.wikipedia.org/wiki/Comrades_Marathon
3. Chase, Z. (2024, May 30). *Ultrarunning Growth in the U.S. Through a Geographic Lens.* iRunFar. Retrieved from https://www.irunfar.com/ultrarunning-growth-in-the-u-s-through-a-geographic-lens
4. MySQL 8.4 Reference Manual (n.d.). Retrieved from https://dev.mysql.com/doc/refman/8.4/en/