Unmanned Surface Vessel (USV) Fleet Management System

Project Step 3

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Project Overview and Database Outline

Overview

The United States Navy currently owns an ever growing fleet of approximately 25 Unmanned Surface Vessels (USVs) ranging from small 24-foot reconnaissance craft to medium-sized autonomous vessels roughly 180 ft in length. All of these vessels are modular, meaning that they can be outfitted with one or many payloads or sensor packages. Payloads are either mounted on the back of the vessel or fixed to the mast and include sensors such as a sonar towed array, electronic warfare (EW) suites, and high definition optical sensors. Currently, the personnel assigned to each vessel and the payloads installed on them are all tracked by hand and usually there are many versions of the same file floating around, with minor or major differences. This database-driven website will allow the commands in charge of USVs to have a centralized interface to track USV status (deployed, deployable, training, etc.), which of the 200 crew members are assigned to each vessel, and whether each crew member is qualified or not. Qualifications tracked are limited to USV Operator and USV Supervisor for this application, but could be expanded in the future with the limitless qualifications afforded to the US Navy. With 25 USVs capable of carrying anywhere from one to six payloads, commands can keep track of nearly 150 different mission packages in this database.

Example questions that could be answered (with relative ease) with this project:

- Which deployable USVs currently have a sonar payload installed and a qualified operator assigned?
- Which USV is a particular crew member assigned to?
- When was a particular payload installed on its assigned USV?
- What USVs are currently deployed?
- Is the entire crew of a specified USV fully qualified to operate it?
- What is the vessel class for a USV with a given name?
- What USVs are currently assigned to a mission in a specific location (e.g., "Mediterranean Sea")?
- What is the priorityLevel and location of the mission assigned to a specific USV?

Database Outline

USVs

- Description: Stores the core details and current operational readiness of each Unmanned Surface Vessel (USV).
- Attributes:
    - usvID: int, auto_increment, unique, not NULL, PK
    - name: varchar(50), not NULL (e.g. “Seahunter”)
    - class: varchar(50), not NULL (e.g. “MUSV”)
    - status: varchar(25), not NULL (e.g. “Deployable”, “Maintenance”)
    - missionID: int, FK, identifies mission the USV is assigned to
- Relationships:
    - Has a 0..1 USVs: 0..M Payloads; usvID is a FK in Payloads.
    - Has a 1..M USVs: 0..1 Missions; missionID is a FK in USVs.
    - Has a 1 USVs: 1..M CrewMembers; usvID is a FK in CrewMembers.

Payloads

- Description: Tracks modular sensors and hardware equipment capable of being mounted on various USVs.
- Attributes:
    - payloadID: int, auto_increment, unique, not NULL, PK
    - type: varchar(50), not NULL (e.g. “Sonar Towed Array”)
    - serialNumber: varchar(50), unique, not NULL
    - condition: varchar(25), not NULL (e.g. “Operable or Inoperable”)
    - usvID: int, FK, identifies the primary USV the payload is installed on
    - installationDate: date
- Relationships:
    - Has a 0..M Payloads: 0..1 USVs; usvID is a FK in Payloads

CrewMembers

- Description: Records details of the Sailors (Operators and Technicians) responsible for fleet operations.
- Attributes:
    - crewMemberID: int, auto_increment, unique, not NULL, PK
    - firstName: varchar(50), not NULL
    - lastName:varchar(50), not NULL
    - rank: varchar(10), not NULL (e.g. “E6” or “O3”)
    - usvID: int, FK, identifies the primary USV the member is currently assigned to
- Relationships:

    - Has an 0..M CrewMembers: 0..M Qualifications facilitated via the CrewQualifications intersection table.
    - Has a 1..M CrewMembers: 1 USVs; usvID is a FK in CrewMembers.

Qualifications

- Description: Stores a master list of qualifications available to personnel (“USV Operator”, “USV Supervisor”
- Attributes:
    - qualificationID: int, auto_increment, unique, not NULL, PK
    - name: varchar(50), not NULL (e.g. “USV Operator”)
- Relationships:
    - Has an 0..M Qualifications: 0..M CrewMembers via the CrewQualifications intersection table.

CrewMemberQualifications (Intersection Table)

- Description: Facilitates the M:M relationship between CrewMembers and Qualifications, allowing a Sailor to hold multiple qualifications.
- Attributes:
    - crewMemberQualificationID: int, auto_increment, unique, not NULL, PK
    - crewMemberID: int, not NULL, FK; links to CrewMembers
    - qualificationID: int, not NULL, FK; links to Qualifications.
    - earnedDate: date, not NULL
- Relationships:
    - Facilitates 0..M CrewMembers: 0..M Qualifications relationship.

Missions

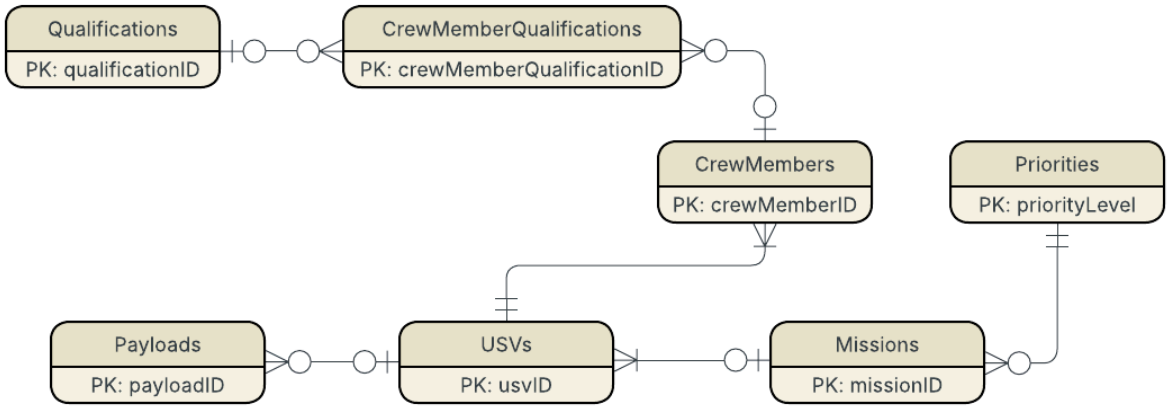
- Description: Records operational objectives, locations, and priority for USV deployment.
- Attributes:
    - missionID: int, auto_increment, unique, not NULL, PK
    - title: varchar(100), not NULL (e.g., 'Operation Ghost Net')
    - location: varchar(100), not NULL (e.g. “Southern California”, “Mediterranean Sea”)
    - priorityLevel: int, not NULL, FK; links to Priorities
- Relationships:
    - Has a 0..1 Missions: 1..M USVs; missionID is a FK in USVs.
    - Has a 0..M Missions: 1 Priorities, FK constraint priorityLevel in Missions.

Priorities

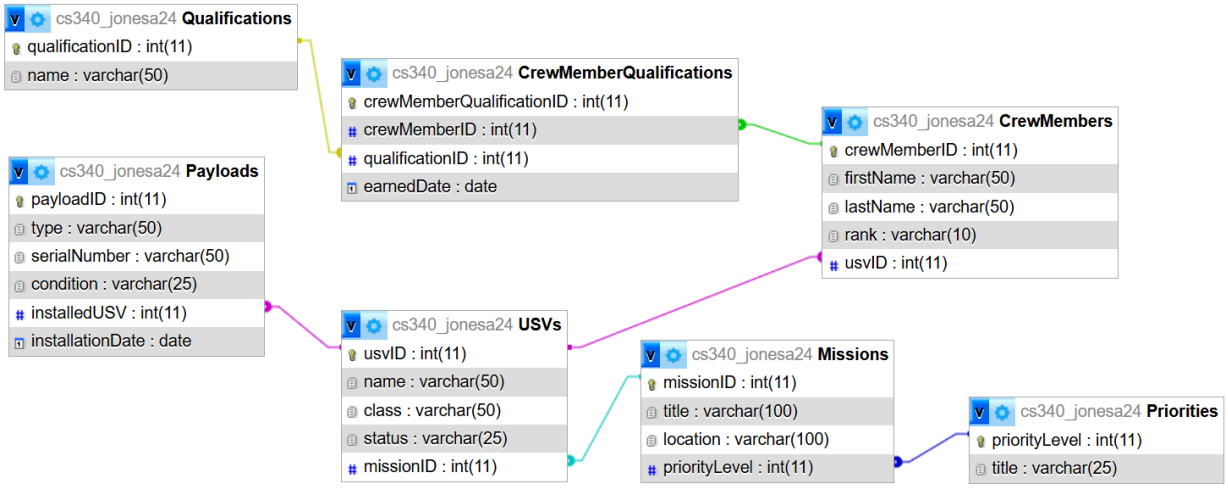
- Description: designates level of “Low”, “Medium”, or “High” based on ID 1, 2, and 3 respectively.
- Attributes:

    - priorityID: int, auto_increment, unique, not NULL, PK
    - title: varchar(25), not NULL
- Relationships:
    - Has a 1 Priorities: 0..M Missions, FK constraint priorityLevel in Missions.

Entity-Relationship Diagram



Schema Diagram



Example Data

Table Name: USVs

usvID	name	class	status	missionID
1	Sentinel	MASC	Deployed	1
2	Striker	MASC	Training	NULL
3	Wraith	GARC	Deployed	3
4	Ghost	GARC	Deployed	3
5	Raider	GARC	Maintenance	NULL

Table Name: Missions

missionID	title	location	priorityLevel
1	Silent Aegis	South China Sea	3
2	Swift Talon	Red Sea	1
3	Pacific Watch	Hawaiian Islands	2

Table Name: Payloads

payloadID	type	serialNumber	condition	installedUSV	installationDate
1	EW	SA-EW-26-001	Operable	1	2025-05-31
2	EW	SA-EW-26-002	Operable	3	2026-01-12
3	EW	SA-EW-26-003	Operable	4	2025-12-20
4	SONAR	DL2-SN-26-101	Operable	1	2025-05-31
5	SONAR	DL2-SN-26-102	Inoperable	2	2025-10-15
6	SONAR	DL2-SN-26-103	Operable	NULL	NULL
7	EO/IR	A7-HD-26-501	Inoperable	NULL	NULL
8	EO/IR	A7-HD-26-502	Operable	1	2025-05-31
9	EO/IR	A7-HD-26-503	Operable	2	2025-10-15

Table Name: Priorities

priorityLevel	title
1	Low
2	Medium
3	High

Table Name: CrewMembers

crewMemberID	firstName	lastName	rank	usvID
1	Marcus	Thorne	O-3	1
2	Sarah	Jenkins	RW1	1
3	Felipe	Torres	ET2	1
4	Davis	Miller	O-3	2
5	James	Shaw	ET1	2
6	Maya	Rodriguez	RW2	2
7	Christopher	Evans	O-3	3
8	Liam	Foster	RW1	3
9	Samantha	Reed	RW2	3
10	Hannah	White	O-3	4
11	Caleb	Wright	ET1	4
12	Sophia	Morales	ET2	4
13	Michael	Sterling	O-3	5
14	Aaron	Choi	RW1	5
15	Ryan	Bennett	RW2	5

Table Name: Qualifications

qualificationID	name
1	USV Craft Master
2	USV Supervisor
3	USV Operator

Table Name: CrewMemberQualifications

crewMemberQualificationID	crewMemberID	qualificationID	earnedDate
1	1	1	2024-10-01
2	1	2	2024-06-01
3	1	3	2024-03-01
4	2	2	2024-12-01
5	2	3	2024-08-01
6	3	3	2025-08-20
7	4	1	2024-10-01
8	4	2	2024-06-01
9	4	3	2024-03-01
10	5	2	2024-12-01
11	5	3	2024-08-01
12	7	1	2024-10-01
13	7	2	2024-06-01
14	7	3	2024-03-01
15	8	2	2024-12-01
16	8	3	2024-08-01
17	9	3	2025-08-20
18	10	1	2024-10-01
19	10	2	2024-06-01
20	10	3	2024-03-01
21	11	2	2024-12-01
22	11	3	2024-08-01
23	13	1	2024-10-01
24	13	2	2024-06-01
25	13	3	2024-03-01
26	14	2	2024-12-01
27	14	3	2024-08-01

Fixes based on Feedback from Step 1

From the feedback we received from the class and TAs, we made minor changes from Step 1. There were no changes to our project files other than the Overview section in our Step 1 Final Version. We added example questions that our project will be capable of answering under the Overview. We also changed some of the values to better define the scope of numbers of rows the project will be handling (e.g. increased potential qualifications beyond 2, and crew size up to 200).

In the down time and while Alex Jones was writing the DDL, some design decisions were updated.

- Relationship between **USVs and Missions** was changed from
    - 1 USVs: 1..N Missions to
    - 1..N USVs: 0..1 Missions
    - Rather than a USV having many missions, a mission can have many USVs and a USV is assigned 1 or 0 missions at a time.
    - Added the FK missionID to USVs and removed the FK usvID from Missions
- Relationship between **CrewMembers and Qualifications** was slightly changed from
    - 1..N CrewMembers: 1..N Qualifications to
    - 0..N CrewMembers: 0..N Qualifications
    - CrewMembers can exist without a qualification and a qualification can exist belonging to no CrewMember
- Relationship between **Payloads and USVs** was changed from
    - 1..N Payloads: 1..N USVs to
    - 0..N Payloads: 0..1 USVs
    - Removed intersection table, now a 1-M relationship. A payload can exist on its own without being installed on a USV. Not categorical so each instance is unique. A USV can have no payloads or N payloads.
    - Added FK constraint to Payloads to indicate whether and which USV it is installed on.
- Added **Priorities** table and **separated priorityLevel from Missions**
    - Added 1 Priorities: 0..N Missions
    - A mission must have a priority level. A priority level can appear in 0 to N missions.
    - Added FK constraint to Missions to indicate what the priority level is.

Feedback from Step 2

Based on feedback received from the step 2 draft, minor changes were made to the overview and DDL SQL file. In the overview, one of the examples for use of the ‘condition’ attribute did not exactly match the wording used in the rest of the files, so that was updated to match. In the DDL SQL file, heading comments were made to separate each section.

Thank you Shayle Senoron and Quinton Gonzales!