BETA TEST PLAN – Neptune AI Drowning Recognition

1. Core Functionalities for Beta Version

For this Beta Test Plan, we focus on Neptune's essential features to ensure stability and reliability in real-world beach patrol conditions.

Feature Name	Description	Priority (High/Medium/Low)	Changes Since Tech3
Neptune Water Surface Detection (NWSD)	Identifies and tracks the water's surface boundary under varying sea and lighting conditions.	Low	New feature
Neptune Human Detection (NHD)	Detects and locates people on the beach and in the water with high accuracy.	Medium	Division of the work between NHD and NDD
Neptune Drowning Detection (NDD)	Recognizes potential drowning events in real time and triggers alerts.	High	N/A
Live Detection Display	Streams real-time outputs from NWSD, NHD, and NDD with overlays.	Low	N/A
Audible Alerts	Issues sound notifications (e.g., "Drowning Alert!") for emergencies.	Low	N/A
2D Homography Beach Map	Projects detections onto a top-down beach map with color-coded markers.	High	New feature

2. Definition of Beta Testing Scenarios

2.1 User Roles

Role Name	Description
Beach Lifeguard	Monitors the beach, responds to alerts, and performs rescues.
System Admin	Manages the Neptune system and hardware.

2.2 Test Scenarios

Scenario 1: Water Surface Detection Accuracy

- **Role Involved:** System Admin
- **Objective:** Test the Neptune Water Surface Detection (NWSD) model's ability to correctly segment water areas.
- **Preconditions:** System camera is positioned correctly.
- **Test Steps:**
    1. Capture video feed in different lighting and weather conditions.
    2. Run NWSD on live footage.
    3. Compare detected water areas with ground truth images.
- **Expected Outcome:** The system correctly identifies water surfaces with at least 90% accuracy.

Scenario 2: Human Detection in the Water

- **Role Involved:** Beach Lifeguard
- **Objective:** Evaluate the Neptune Human Detection (NHD) model in identifying people in the sea.
- **Preconditions:** At least one person is in the water, at varying distances from the camera.
- **Test Steps:**
    1. Monitor video feed with people swimming at different locations.
    2. Run NHD and log detected human figures.
    3. Compare results with actual presence in the water.
- **Expected Outcome:** The system correctly detects humans in 95% of cases without false positives.

Scenario 3: Drowning Pattern Detection & Alert System

- **Role Involved:** Beach Lifeguard
- **Objective:** Validate the Neptune Drowning Detection (NDD) model's real-time alert system.
- **Preconditions:** A controlled test with a swimmer mimicking drowning behavior.
- **Test Steps:**
    1. Simulate a drowning event in view of the camera.

2. Observe if the system generates a "Drowning Alert!" notification with sound.
3. Verify that the lifeguard receives the alert in under 5 seconds.
- **Expected Outcome:** A timely and accurate alert is issued when drowning behavior is detected.

Scenario 4: Hardware Performance Under Environmental Stress

- **Role Involved:** System Admin
- **Objective:** Test Neptune's hardware stability under extreme weather conditions.
- **Preconditions:** System is set up on the beach and exposed to elements.
- **Test Steps:**
  1. Operate the system in direct sunlight, high humidity.
  2. Measure processing speed and temperature stability.
  3. Log any overheating, lag, or hardware failures.
- **Expected Outcome:** The system runs continuously without crashes or major delays.

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3. Coverage of Key User Journeys

Journey: Normal Surveillance

Objective: Ensure effective monitoring without the need to constantly look at the screen.

Key Steps:

- Turning on the Neptune system upon arrival at the post.
- Initial verification that the system is functioning (camera connection, active detection).
- Passive monitoring: the lifeguard does not need to look at the screen unless an alert is triggered.
- In case of an audible alert:
  - The lifeguard listens to the type of alert issued (e.g., "Drowning Alert!").
  - They can choose to check the video feed or act immediately based on the situation.
  - If the danger is not immediately visible (e.g., a crowded beach), the lifeguard may use the video feed to precisely locate the affected area.
- Logging out and shutting down the software at the end of service.

Expected Outcome:

- Smooth monitoring without unnecessary distractions.
- Audible alerts are sufficient to warn of problems.
- The video feed serves as a support tool in cases where the location of the danger is uncertain, particularly on crowded beaches.

Possible Failure Points:

- The audible alert does not trigger despite a detected danger.
- An alert is triggered but is not loud enough to be heard.
- Too many false alerts disrupt monitoring and require excessive screen-checking.
- On a crowded beach, the video feed must provide sufficient clarity to allow quick identification of the danger.

Journey: Responding to a Drowning Alert

Objective: Respond quickly to a drowning detected by Neptune.

Key Steps:

- Passive monitoring by the lifeguard (not constantly watching the screen).
- Neptune triggers an audible alert: "Drowning Alert!".
- Listening and identifying the type of alert.
- If the danger is immediately visible, direct intervention.
- If the danger is unclear, a quick check of the video feed to locate the distressed individual.
- Immediate movement towards the identified area and rescue.
- Deactivation of the alert once the intervention is complete.

Expected Outcome:

- The alert enables an immediate and effective reaction.
- The video feed is used only when necessary to help locate the danger.
- The intervention is quick and well-coordinated.

Possible Failure Points:

- The alert does not trigger despite an ongoing drowning.
- The alert is triggered but is inaudible due to ambient noise.
- The video feed is blurry or delayed, making localization difficult.

Journey: Managing a False Alert

Objective: Identify and handle false alerts to avoid unnecessary interventions.

Key Steps:

- Passive monitoring by the lifeguard.
- Neptune triggers an audible alert.

- Observing the behavior of the concerned individual:
  - Checking the video feed if in doubt.
  - Direct visual verification on the beach.
- If it is a false alert, manual validation in Neptune.
- Adjusting parameters to prevent similar errors in the future.

Expected Outcome:

- Reducing unnecessary interruptions caused by false positives.
- Continuous improvement of the detection model.
- Increased system efficiency without unnecessary alerts for minor events.

Possible Failure Points:

- Too many false alerts fatigue the lifeguard and reduce their responsiveness.
- The Neptune algorithm does not learn enough from mistakes.
- A false alert is misidentified, and a dangerous situation is ignored.

Journey: Surveillance During Exceptional Crowds

Objective: Ensure effective detection when the beach is overcrowded.

Key Steps:

- Turning on Neptune and verifying the cameras.
- Passive monitoring, with the lifeguard not constantly watching the screen.
- In case of an audible alert, quick danger analysis:
  - Direct visual verification to locate the endangered person.
  - If the crowd prevents immediate identification, checking the video feed to find the individual in question.
- Immediate intervention after precise localization.

Expected Outcome:

- Neptune operates effectively, even when the beach is heavily crowded.
- The video feed assists in locating a person in distress when hidden within the crowd.
- Alerts remain precise, avoiding unnecessary overload due to excessive human movement.

Possible Failure Points:

- Too much human movement confuses the detection, increasing false positives.
- The video feed becomes harder to analyze when the beach is densely packed.
- A real danger is lost within the crowd and detected too late.

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4. Success Criteria

Feature	Criterion	Formula / Method	Unit	Minimum Threshold	Measurement Method	Frequency
NWSD	Detection Accuracy	TP / (TP + FP)	%	≥ 80%	Manual log analysis	After each update
NWSD	Latency	t_alert – t_frame	ms	≤ 500	Software timestamp	Continuous
NHD	Recall	TP / (TP + FN)	%	≥ 80%	Manual comparison vs model output	10 scenarios
NHD	False Positive Rate	FP / (FP + TN)	%	≤ 3%	Event logs	Continuous
NDD	Detection Time	t_alert – t_incident	s	≤ 3	Automated simulation script	5 tests/week
NDD	False Alarm Rate	Number of false alarms ÷ total alerts	%	≤ 5%	Manual review	After each test
Live Display	Refresh Rate	1 / (update interval)	Hz	≥ 1	Profiling tool	Continuous
Sound Alerts	Alert Volume	Measured SPL level	dB	≥ 85	Sound level meter	One-time test
2D Map	Homography Accuracy	Mean reprojection error	m	≤ 1	Average distance between projected and true points	10 test points
System Usability	SUS Score	Standard System Usability Scale	score	≥ 80	SUS questionnaire filled by sea guards	After beta test

Feature	Task Criterion	Formula / Method	Unit	Minimum Threshold	Measurement Method	Frequency
Alert Acknowledgement	Completion Time	t_ack – t_alert	s	≤ 5	Software timestamp	Continuous

5. Known Issues & Limitations

Issue	Description	Impact	Planned Fix? (Yes/No)
False Drowning Alerts	Some activities (e.g., diving) are misclassified as drowning.	Medium	Yes
No Drowning Alerts	No alert in case of drowning.	High	Yes
Human Detection from a far distance	Detecting a human from a far distance is very challenging (can be confuse with other objects or not detected)	High	Yes

6. Conclusion

This Beta Test Plan ensures that Neptune AI's drowning detection and monitoring capabilities are reliable in real-world conditions. The outlined test scenarios, success criteria, and mitigation plans aim to optimize performance and user experience, making Neptune an invaluable tool for beach safety.