Sensor for Hatcheries

Final Product Design

452 New Product Design

Group 3: Christie Anderson · Yiying Pang · Emi Kobayashi · Dean Wu

*Protecting shellfish larvae
through real-time carbonate monitoring.*

The Problem

Ocean Acidification in Shellfish Hatcheries

Larvae Are Fragile

Vulnerable to carbonate changes in the first 24–48 hours of life

Shell Formation Fails

Acidification blocks calcification, causing rapid mass mortality

Manual & Reactive

Current monitoring is slow and discovers problems only after damage

Massive Losses

75–80% larval loss per batch — lost cycles and high replacement costs

The Need: Continuous, real-time carbonate monitoring to catch problems before larvae die.

Customer Persona

> *By the time we see the problem, it's already too late.*

Sarah Martinez

Hatchery Operations Manager

- Mid-sized commercial shellfish hatchery
- Pacific Northwest (coastal)
- 12 years in aquaculture

MANAGES

- Water intake systems
- Larval tanks & production schedules
- Staff technicians
- Survival rate metrics

Goals

- Maximize larval survival in first 48hrs
- Maintain predictable production cycles
- Reduce emergency interventions
- Avoid costly batch crashes

Pain Points

- Sudden pH drops at night or during storms
- Manual sampling misses rapid changes
- Problems found only after larval failure
- Losing 70–80% of a cohort after days of work

What Wins Her Over

- Real-time alerts before mortality begins
- Continuous system, no extra staff needed
- Data she can trust for dosing decisions
- Clear ROI tied to prevented larval losses

Buying Motivation:

Protects revenue · Reduces staff stress · Makes production predictable · Delivers measurable survival improvement

Customer Needs

Voice of the Customer

Real-Time Detection

Continuous carbonate chemistry monitoring, no gaps

Design Insight: Visibility creates control. Operators need live situational awareness to move from reactive response to proactive prevention.

Accurate Measurement

Reliable pH and alkalinity readings for dosing decisions

Design Insight:
Trust drives action. If the data is inconsistent or unclear, operators hesitate, and delay increases risk.

Robust Hardware

Resistant to biofouling, bubbles, and turbulent water

Design Insight:
The environment is messy and dynamic. The product must be resilient by design, not fragile in real-world conditions.

Reduces Costs

Affordable system that cuts manual labor and prevents losses

Design Insight:
The hatchery cannot redesign its infrastructure for the sensor. The sensor must adapt to existing operational realities.

Prevents Losses

Intervenes before larvae stop developing, not after

Design Insight:
Adoption depends on operational relief. Technology must simplify workflows and justify its cost through measurable impact.

Sustainable

No chemical reagents; low maintenance in hatchery conditions

Design Insight:
The goal is prevention, not diagnosis. Success is measured in avoided losses, not collected data.

These needs drove our design — every feature maps directly to a customer requirement.

Proposed Product

Continuous Carbonate Monitoring Sensor

Product Concept

Reagent-less solid-state sensor for continuous carbonate monitoring in hatchery water.

CORE FEATURES

- Real-time pH and alkalinity measurement
- Continuous sampling (<60 sec intervals)
- Automated alerts for risky conditions
- Buffering system integration

DESIGN ADVANTAGES

- No chemical reagents required
- Compact, tank/intake-ready form factor
- Resistant to bubbles & biofouling
- Automated data logging

Output: Live data with mobile/computer alerts and control system integration.

AT A GLANCE

<60s

sampling interval

24/7

continuous operation

0

chemical reagents

Value Proposition

Why Hatcheries Need This Technology

Economic

- Prevents larval loss
- Protects valuable cohorts
- Cuts manual labor costs

Operational

- 24/7 real-time monitoring
- Early acidification warnings
- Boosts production reliability

Technical

- Accurate carbonate measurement
- Low maintenance design
- Suited for hatchery conditions

Result: Better survival rates, lower operational costs, and predictable production cycles.

Product Impact & Future Applications

Aquaculture and Ocean Monitoring

Primary Impact

Protects shellfish hatcheries

Stabilizes larval seed supply for regional farms

Industry Benefits

Boosts productivity · Enhances sustainability · Reduces ocean chemistry risks

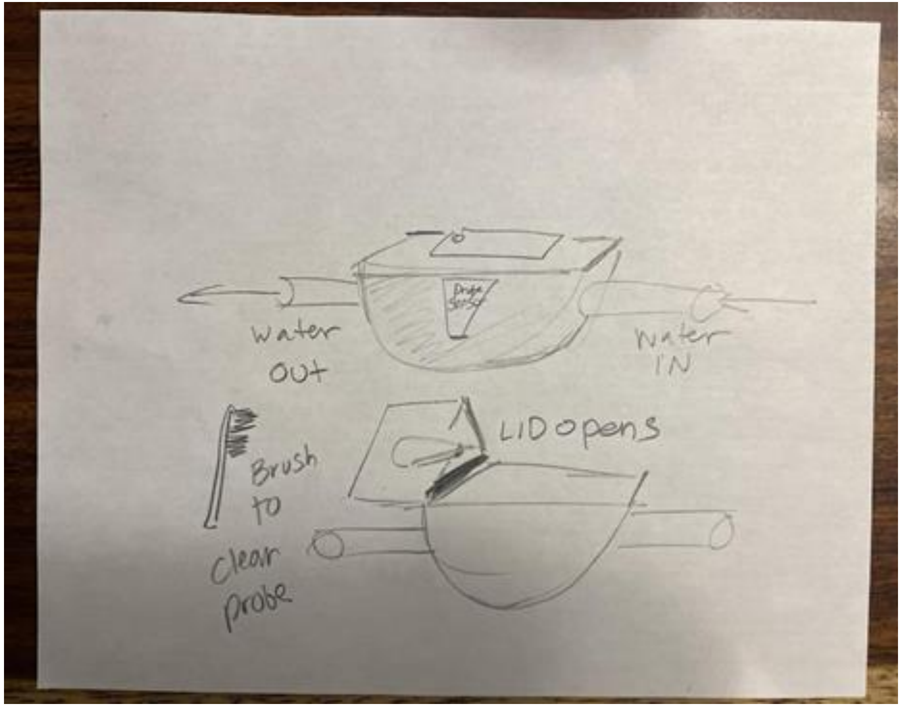
Future Applications

- Coastal and aquaculture monitoring networks
- Marine research stations and environmental sensors
- Expanded to oyster, clam, and salmon facilities
- Real-time ocean health data for climate research

Vision: A scalable system helping aquaculture adapt to ocean change — protecting food systems, not just hatcheries.

Version 1

Early Prototype — Inline Flow-Through Design

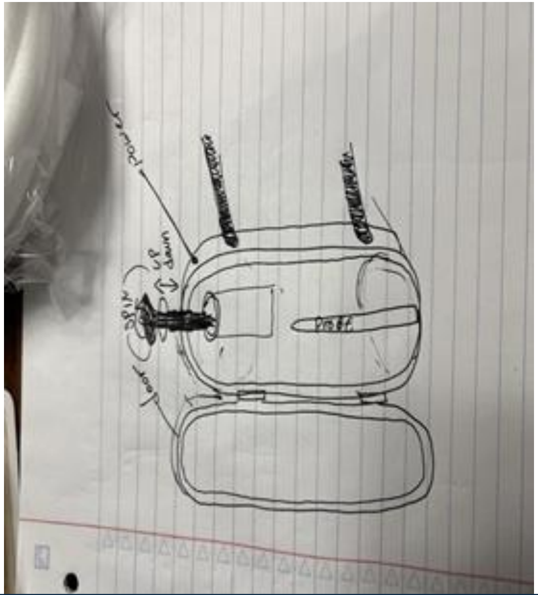


Design Sketch — Water In/Out + Lid Opening

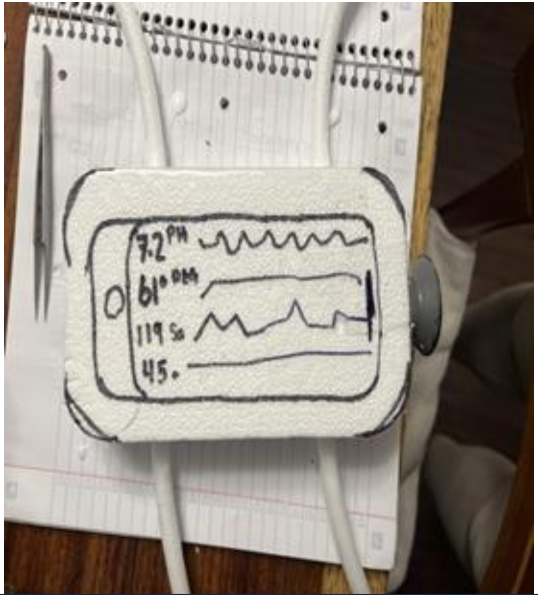
Materials & Early Assembly

Version 2

Refined Prototype — Compact Sensor Housing



Sketch — Probe + Spin Mechanism



Dashboard Display Mock-up

Physical Foam Prototype

V2 improvements: Compact oval housing · Spin dial for probe depth adjustment · Integrated display panel · Improved cleanability

Thank You

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NEXT STEPS

1. Finalize sensor electronics and calibration
2. Conduct hatchery field testing with operators
3. Validate alkalinity measurement accuracy
4. Explore partnership with shellfish producers
5. Develop mobile alert & dashboard interface