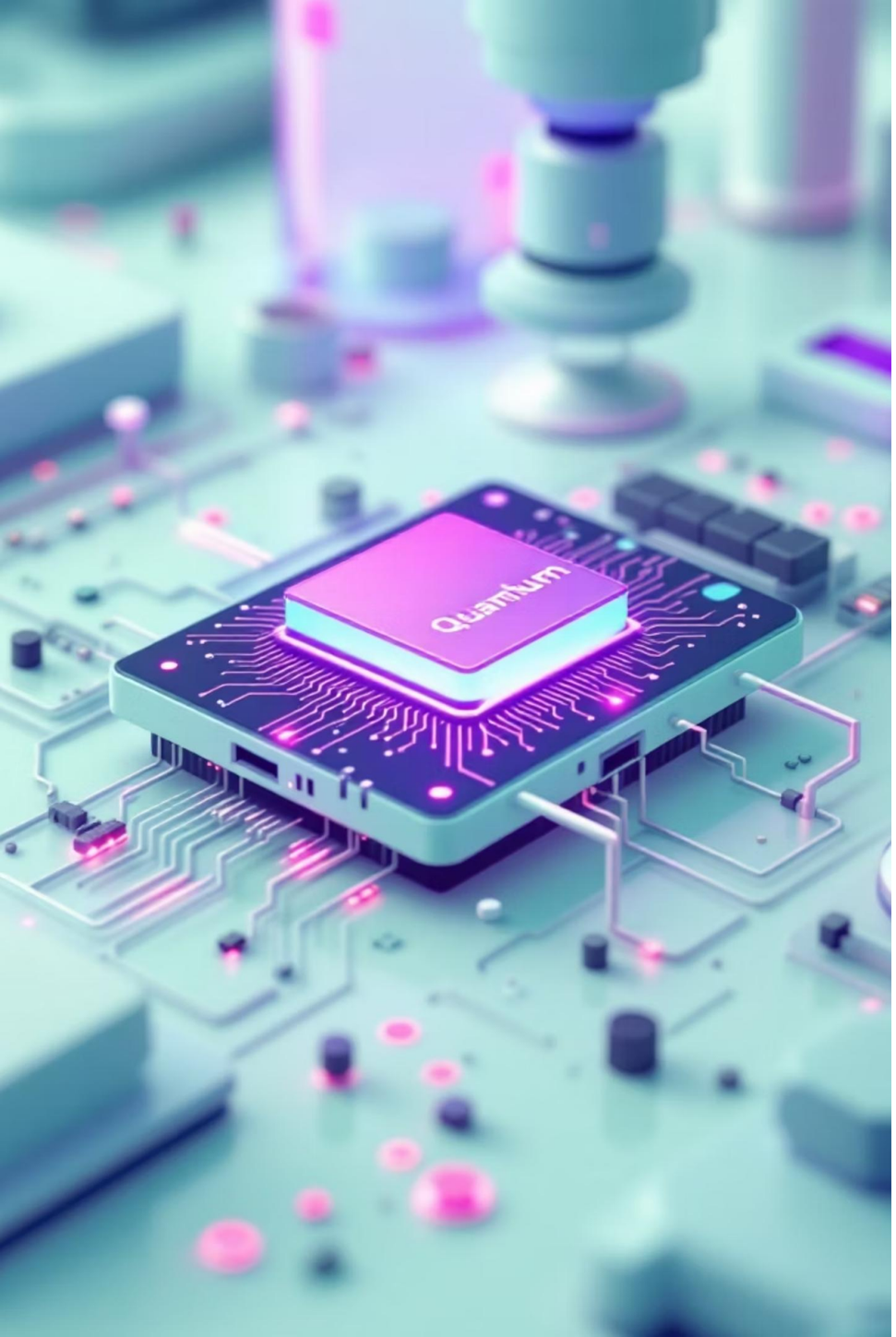


Quantum War Room: Project Elitzur

Elitzur-Vaidman Challenge

Team Beerantum – Rudraksh

November 14, 2025

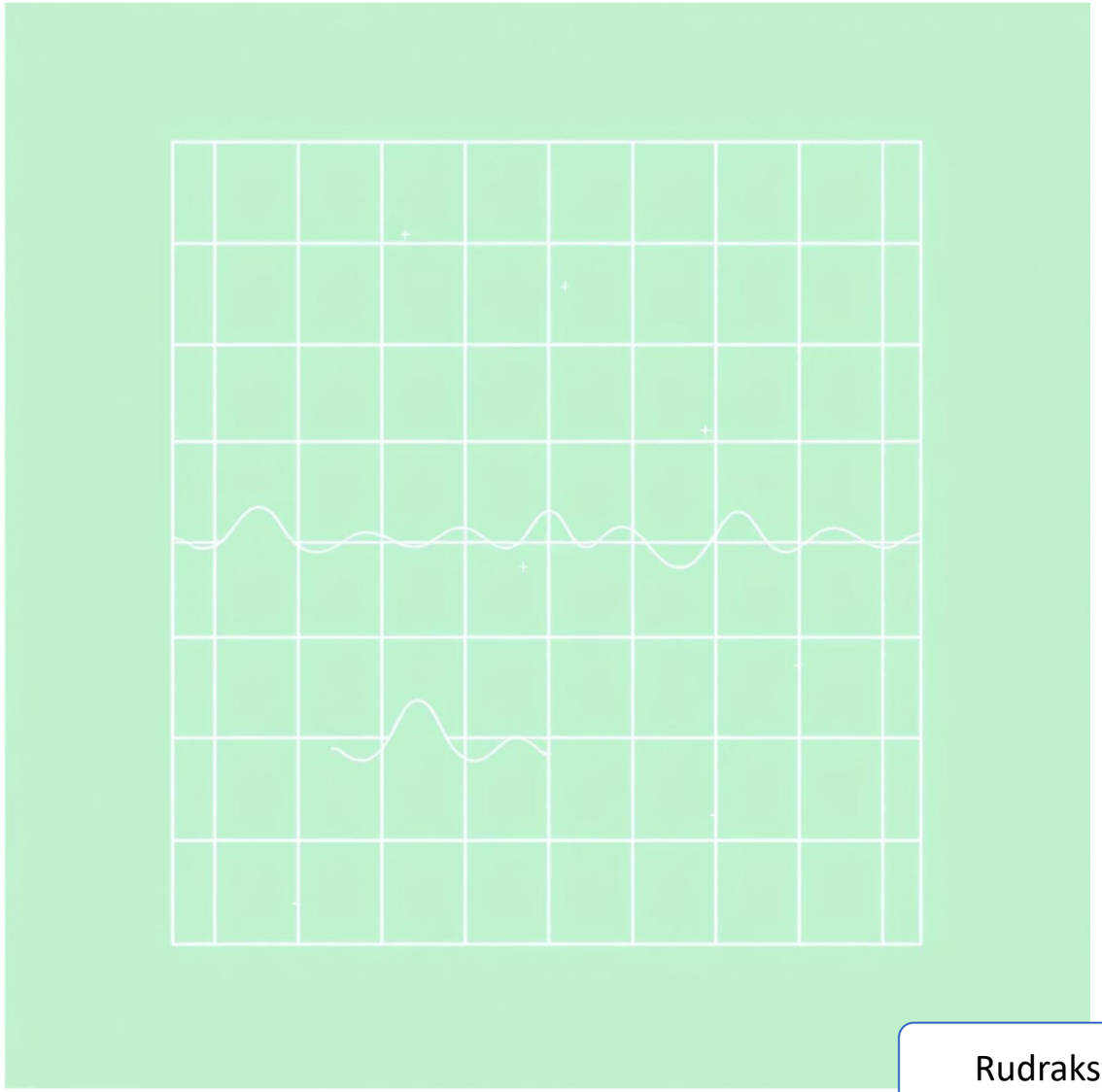
Rudraksh

The Challenge: Quantum Battleship

The core task was to extend the Elitzur-Vaidman "bomb tester" concept to a Battleship grid—locating ships without directly hitting them.

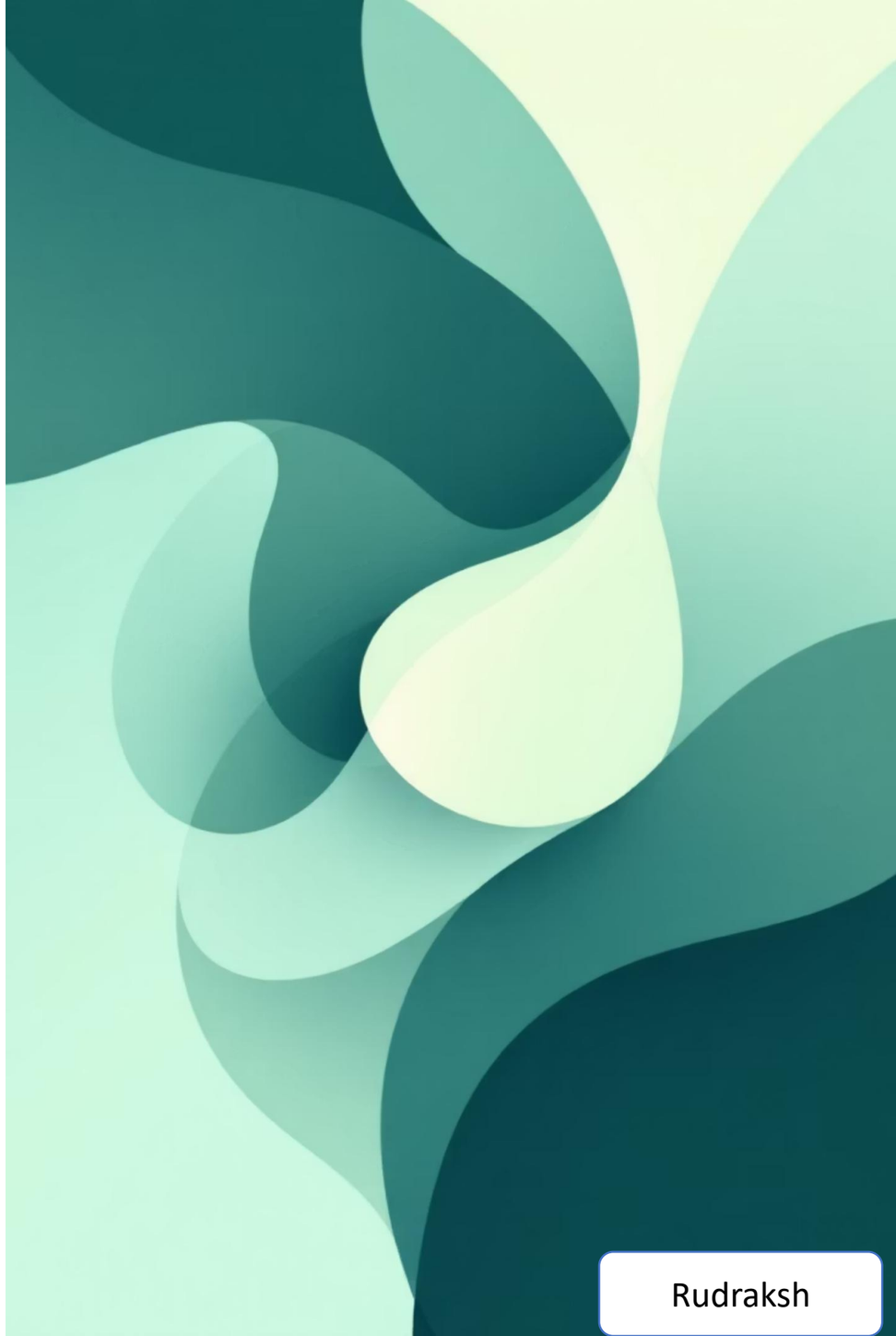
The Goals

- Design a quantum circuit to locate ships without "hitting" them
- Showcase the power of quantum interference and superposition
- Deliver a working prototype with a clear project pitch

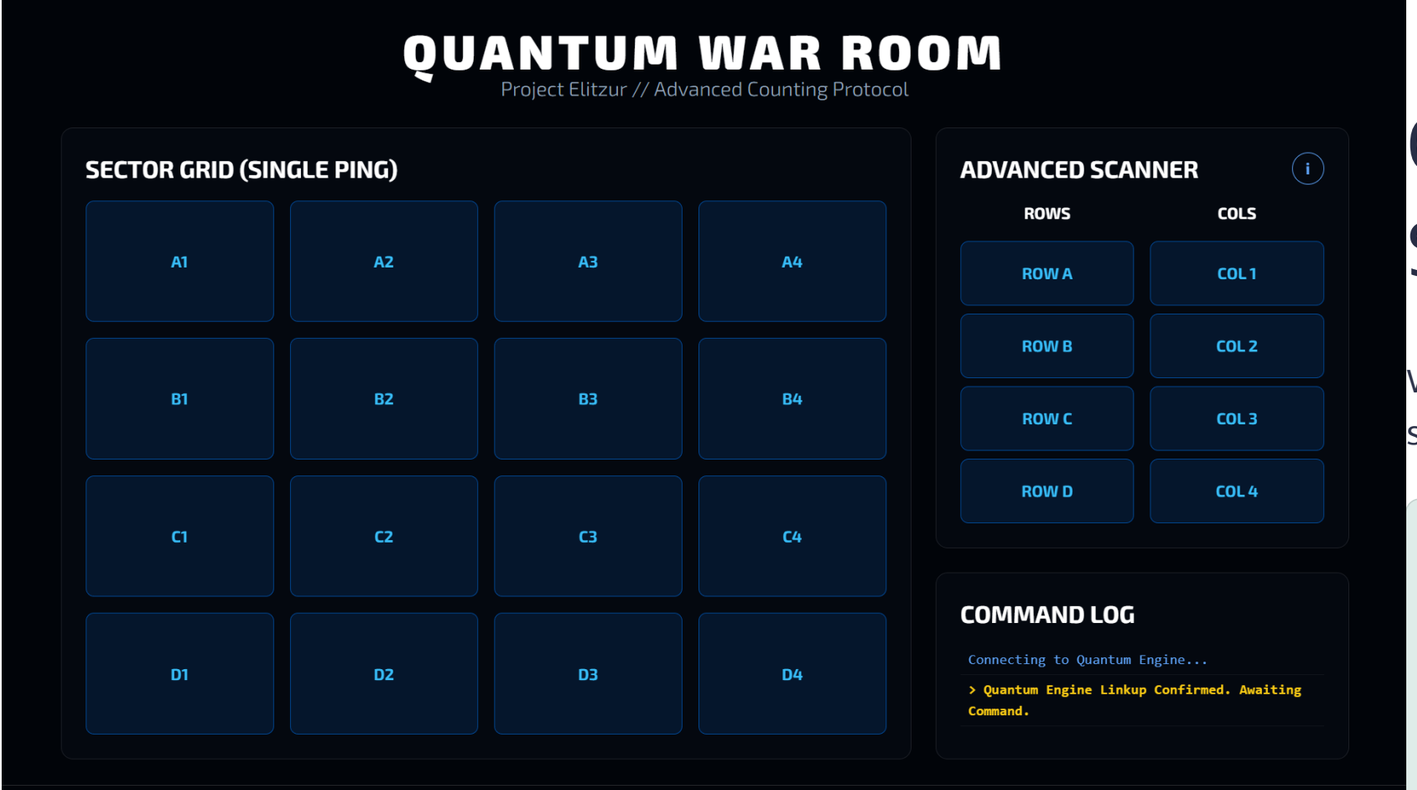


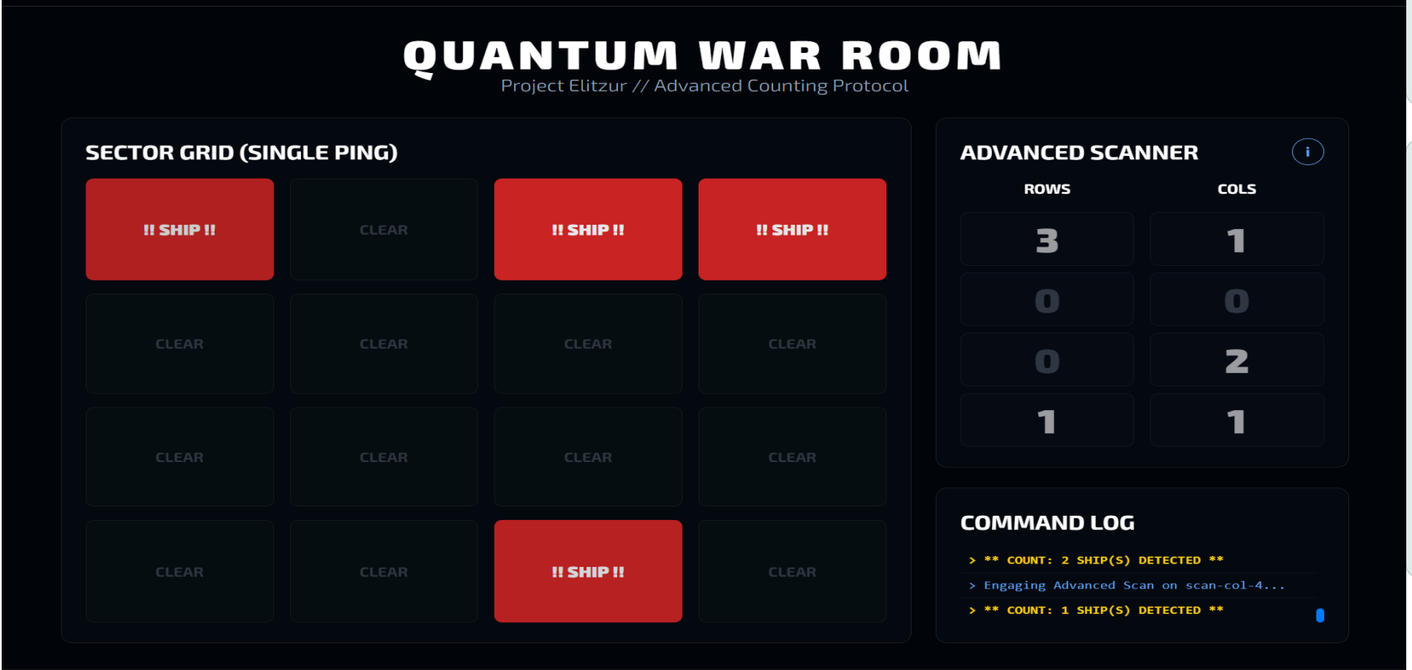
Rudraksh

We believe a project must not only meet the goals, but exceed them.



Rudraksh





Our Solution: A Two-Mode System

We engineered a full-stack web application with two distinct scanning modes:

Mode 1: Basic Ping

A 2-qubit Elitzur-Vaidman circuit that "pings" a single grid square. Fulfills the core task requirement.

Mode 2: Advanced Counter

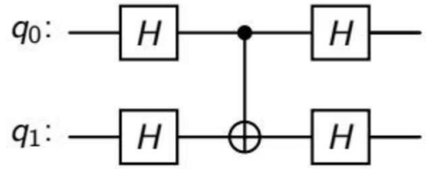
A 7-qubit Quantum Phase Estimation circuit that "scans" an entire row or column, returning the exact number of ships in parallel.

Rudraksh

Mode 1: The Elitzur–Vaidman Circuit

How It Works

Uses an interferometer to detect a ship without "touching" it. We implement a CNOT gate:



- **No ship (|0⟩):** Probe qubit interferes with itself and returns |0⟩
- **Ship present (|1⟩):** Ship's presence breaks interference. Probe returns |1⟩

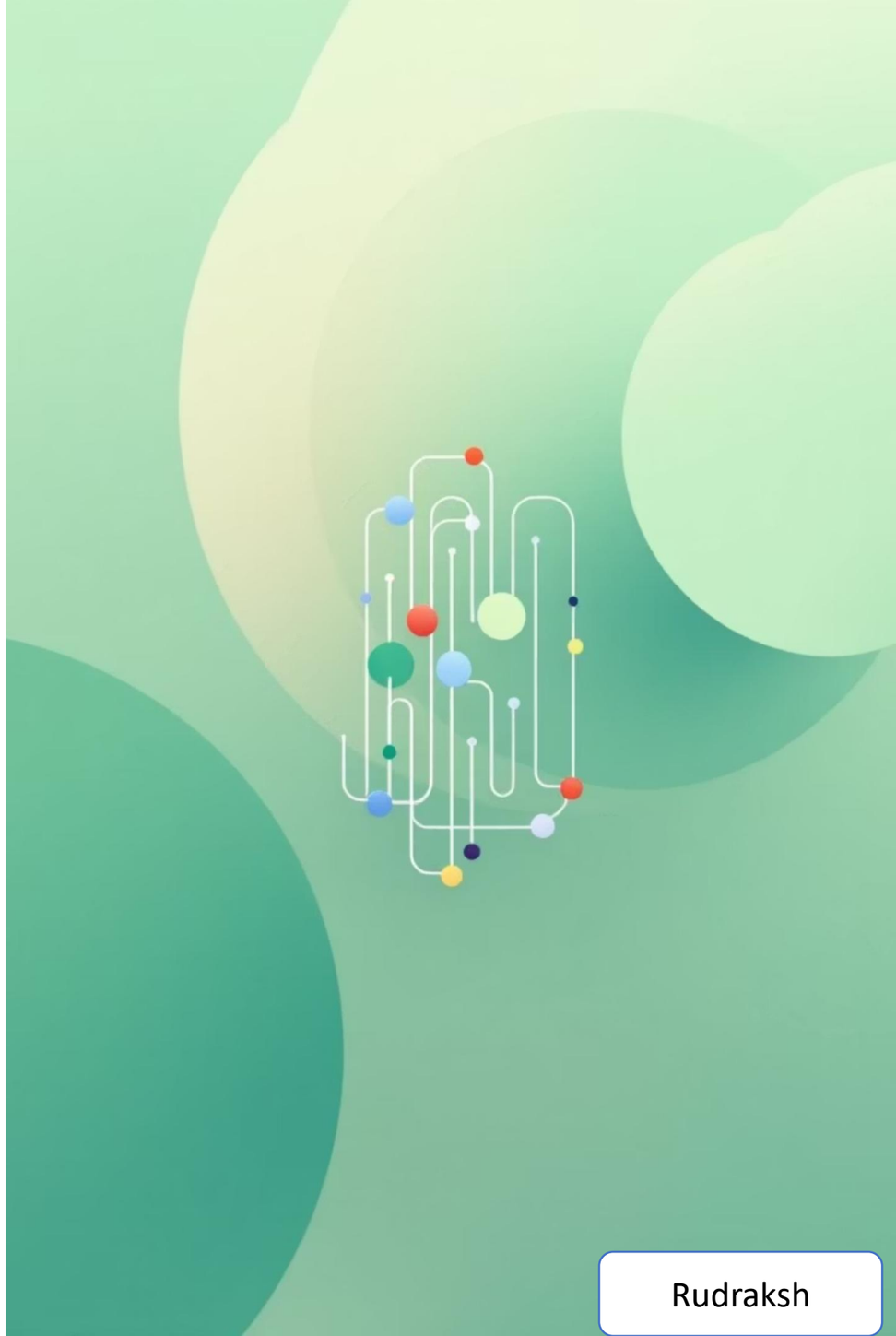
q0: Probe Qubit**q1:** Target Qubit (Ship/Water)

Rudraksh

Mode 2: True Quantum Parallelism

> Scanning 4 squares one-by-one is "classical." A **true** quantum solution scans them in parallel.

Our 7-qubit Quantum Phase Estimation circuit achieves genuine quantum advantage by scanning entire rows or columns simultaneously—a task impossible for classical machines.



Rudraksh

Checking the Boxes

We built our project to excel at all four judging criteria:

1

Innovation

We didn't just build the EV tester. We created a 7-qubit quantum counter based on Phase Estimation, a far more complex and powerful algorithm.

2

Feasibility

Our project is a fully working, deployed web application. It's a complete, polished product, not a notebook simulation.

3

Quantum Relevance

Our solution is 100% quantum. The "Advanced Counter" uses superposition and phase manipulation to achieve true quantum parallelism.

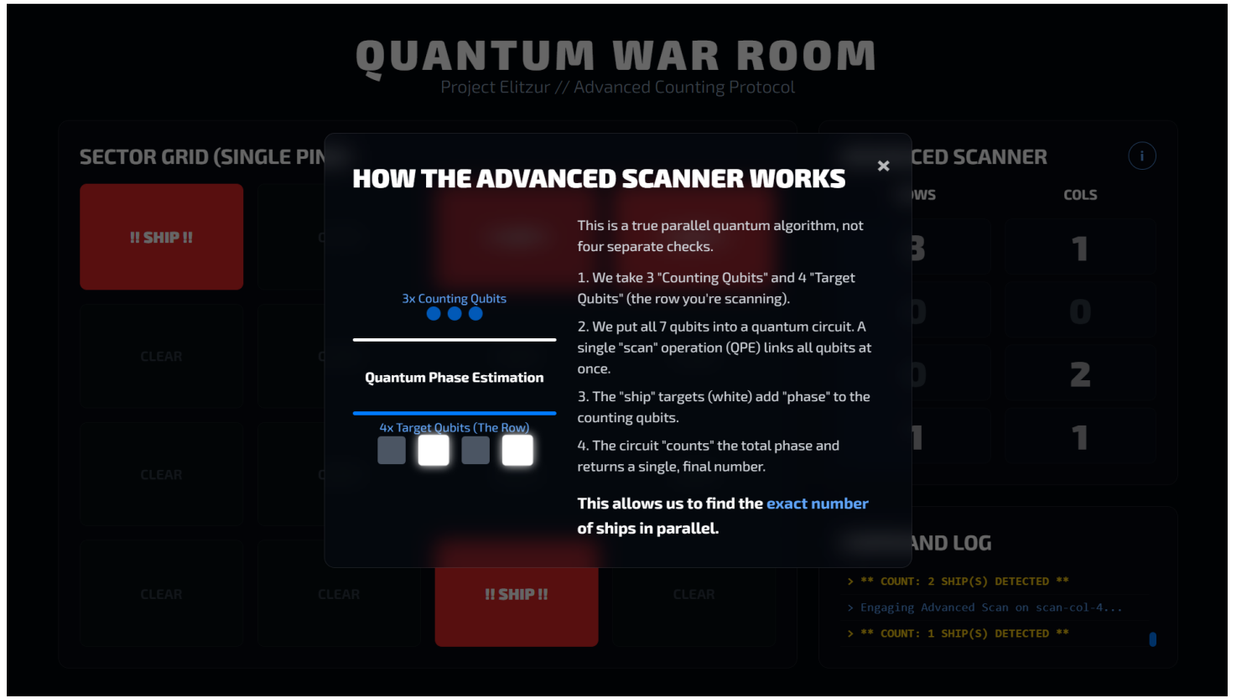
4

Clarity

We built a intuitive UI and a built-in animated explainer to make our complex algorithm understandable to any judge.

Rudraksh

Technical Architecture



Frontend

Responsive JavaScript interface with intuitive controls and real-time visualization

Backend

Flask server handling quantum circuit execution and state management

Quantum Engine

Qiskit-powered quantum circuits running on IBM quantum simulators

Rudraksh

The Quantum Advantage

Classical Approach

- Sequential scanning
- One square at a time
- Linear time complexity
- No interference effects

Quantum Approach

- Parallel superposition
- Entire rows/columns at once
- Exponential speedup potential
- Phase estimation precision

Rudraksh

Thank You

Team Beerantum

Rudraksh Sharma

Rudraksh