

Quantum War Room: Project Elitzur

Elitzur-Vaidman Challenge

Team Beerantum – Rudraksh

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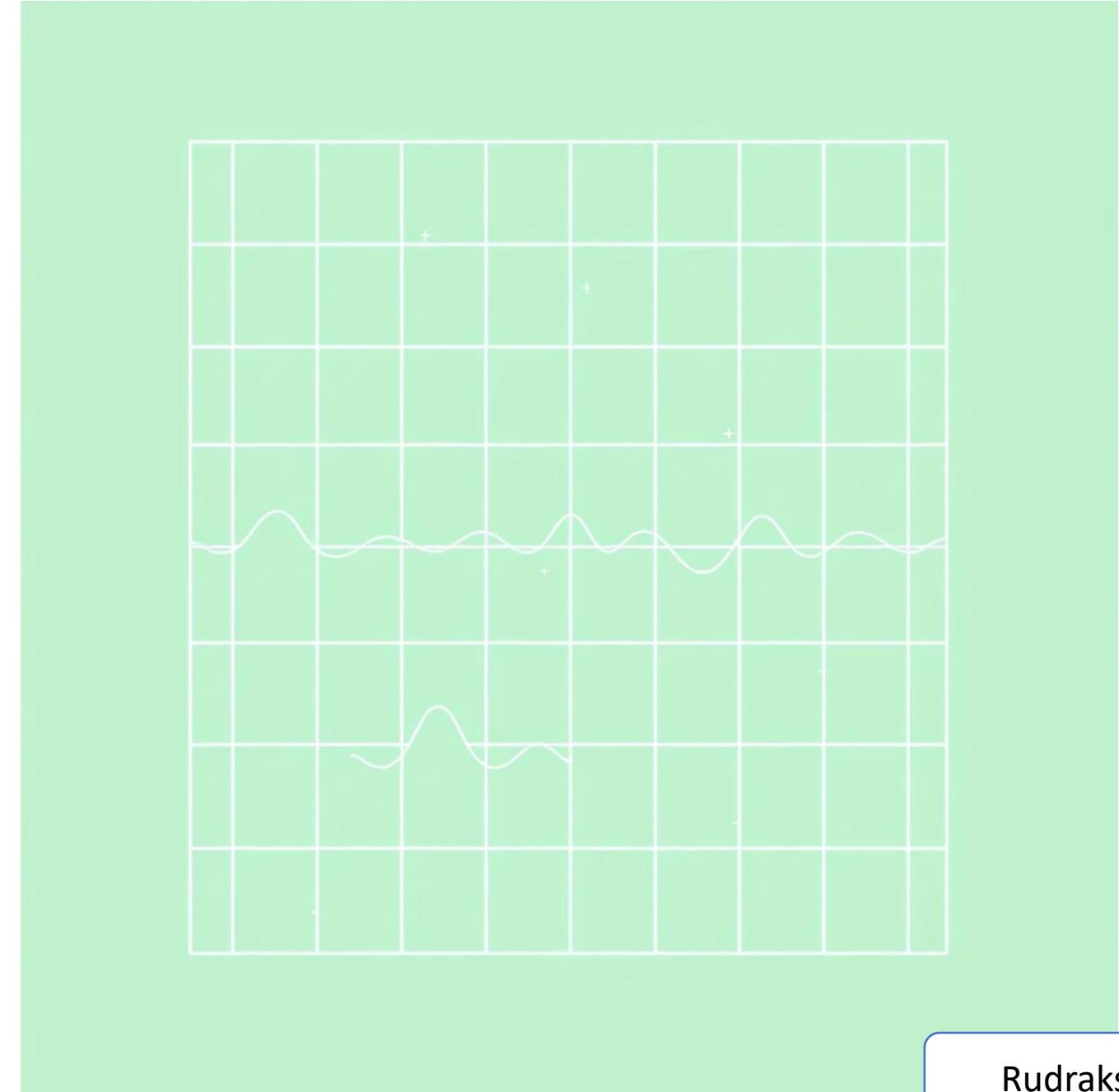
Rudraksh

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



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



QUANTUM WAR ROOM

Project Elitzur // Advanced Counting Protocol

SECTOR GRID (SINGLE PING)

A1	A2	A3	A4
B1	B2	B3	B4
C1	C2	C3	C4
D1	D2	D3	D4

ADVANCED SCANNER

ROWS	COLS
ROW A	COL 1
ROW B	COL 2
ROW C	COL 3
ROW D	COL 4

COMMAND LOG

Connecting to Quantum Engine...
> Quantum Engine Linkup Confirmed. Awaiting Command.

QUANTUM WAR ROOM

Project Elitzur // Advanced Counting Protocol

SECTOR GRID (SINGLE PING)

!! SHIP !!	CLEAR	!! SHIP !!	!! SHIP !!
CLEAR	CLEAR	CLEAR	CLEAR
CLEAR	CLEAR	CLEAR	CLEAR
CLEAR	CLEAR	!! SHIP !!	CLEAR

ADVANCED SCANNER

ROWS	COLS
3	1
0	0
0	2
1	1

COMMAND LOG

> ** COUNT: 2 SHIP(S) DETECTED **
> Engaging Advanced Scan on scan-col-4...
> ** COUNT: 1 SHIP(S) DETECTED **

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

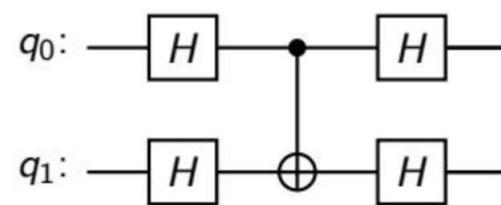
Mode 1: The Elitzur-Vaidman Circuit

How It Works

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

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

q_0 : Probe Qubit q_1 : Target Qubit (Ship/Water)



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.



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

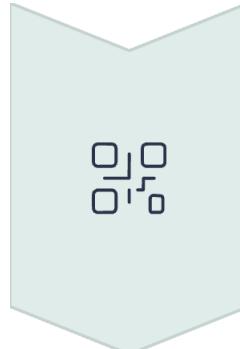
Our solution is 100% quantum. The "Advanced Counter" uses superposition and phase manipulation to achieve true quantum parallelism.

4

Clarity

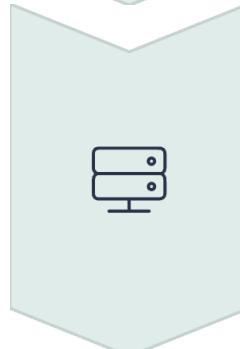
We built a intuitive UI and a built-in animated explainer to make our complex algorithm understandable to any judge.

Technical Architecture



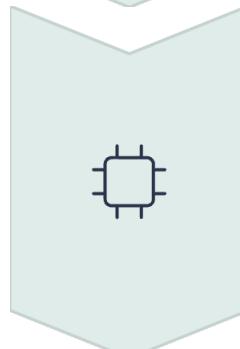
Frontend

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

The screenshot shows a dark-themed user interface titled "QUANTUM WAR ROOM" with the subtitle "Project Elitzur // Advanced Counting Protocol". At the top left is a "SECTOR GRID (SINGLE PIN)" section with a red button labeled "!! SHIP !!". To its right is a "HOW THE ADVANCED SCANNER WORKS" section containing the following text:

This is a true parallel quantum algorithm, not four separate checks.

1. We take 3 "Counting Qubits" and 4 "Target Qubits" (the row you're scanning).
2. We put all 7 qubits into a quantum circuit. A single "scan" operation (QPE) links all qubits at once.
3. The "ship" targets (white) add "phase" to the counting qubits.
4. The circuit "counts" the total phase and returns a single, final number.

This allows us to find the exact number of ships in parallel.

Below this are sections for "CED SCANNER", "ROWS", "COLS", and a "LOG" area with the following entries:

- > ** COUNT: 2 SHIP(S) DETECTED **
- > Engaging Advanced Scan on scan-col-4...
- > ** COUNT: 1 SHIP(S) DETECTED **



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

Thank You
Team Beerantum

Rudraksh Sharma



Rudraksh