



## Colorado Science and Engineering Fair

## 2024 Individual Project Abstract Form

**Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.**

Title of Project: Pattern-Based Seismology

Finalist's Name: Tejas Raman

School and City: Boulder Country Day School, Boulder, CO

Sponsor's Name: Ms. Karen Morton

Category: Earth & Environmental Sciences (EAEV)

Division: Junior (6th - 8th grades)

Abstract (250 words or less):

Calibrated seismic instruments that are available to buy today are not only expensive to build and maintain, but they are also hard to operate. However, hardware calibration, which is a strenuous process, can be replaced. One approach that can be taken to replacing hardware calibration is a completely software-based approach to processing raw data from any given uncalibrated sensor.

To test the effectiveness of algorithmic methods of accurately detecting earthquakes, I built a classic vertical-pendulum seismometer using induction principles to generate electricity. The electricity was amplified using 4 operational amplifiers and added to a base voltage of  $\pm 1.66$ . The data is passed into an ADC, which passes the data to an ARM64-based SBC. The data is then transposed to fit onto a scale of 1 to 4096 (in which 1 = 0v and 4096 = 3.3v). Risk assessments are made using the energy of data that is checked against the mean and standard deviation, collected over a 5s calibration period in which the data is sampled approximately 1000 times. While simulating an earthquake, the software was able to detect the difference in input voltage (from the inductive pendulum) and successfully alert the user of an increased risk of an earthquake being present. In conclusion, software can be used to provide reliable and useful information about current seismic activity in real-time using uncalibrated hardware, making earthquake risk detection accessible to a wider audience.

*I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.*

Finalist's Signature: *Tejas Raman*

Date: *7/28/2024*

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.