



Do-It-Yourself Geiger Mueller Smart Detector

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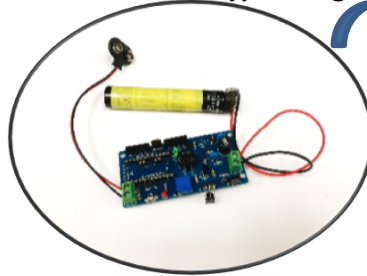
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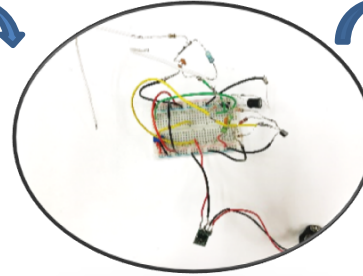
Abstract

Both the Health Physics Society and American Nuclear Society have longstanding programs providing continuing educational workshops, lesson plans, posters, newsletters, and other educational materials for K-12 science teachers. These materials are designed to promote science literacy relating to radiation, but also serve the purpose of interesting students in science, technology, engineering and math (STEM) careers. Experimental kits with radiation detectors are available for loan to teachers, but expense precludes these becoming permanent part of the curriculum. Another professional outreach program to students involves the functional restoration of 1960s-1970s era fallout shelter detectors, typically through the replacement of a capacitor with a shelf life limited to only a couple decades. The distribution of such detectors, while both functional and of nostalgic interest, does little to promote careers in the radiation sciences as exciting ones involving impressive state-of-the-art equipment and cutting edge technology. Student experience with measuring ambient radiation with such antique detectors is also typically a limited one restricted to a single device available during the class period. To overcome these shortcomings, an affordable do-it-yourself radiation detector was designed that students would construct for themselves and be able to keep afterwards. The system is built around Geiger-Muller tubes salvaged from surplus fallout shelter detectors, thus avoiding the expense of the basic detector component. Basic circuit elements will be provided to the students who solder them to a supplied printed circuit board. The radiation detection system is controlled by a Raspberry Pi computer while voltage is increased to the necessary levels with an Arduino micro-controller. A smartphone, communicating using Bluetooth to the Raspberry Pi, will eventually serve as the display. An appropriate application will be created to allow collection of both GPS data and radiation measurements for creating radiation maps. A case, incorporating the detector, cellphone and electronics, will be 3D printed by the students. At the end of the exercise, students will have their own working radiation detection, and will have accumulated experience with practical radiation measurements, Raspberry Pi computers, Arduino micro-controllers, circuit design, 3D printing, and mapping.

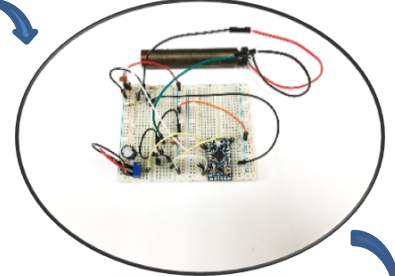
Purchased Prototype Design



First Prototype



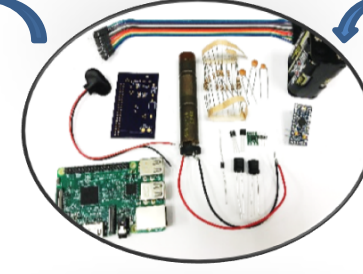
Intermediate Design



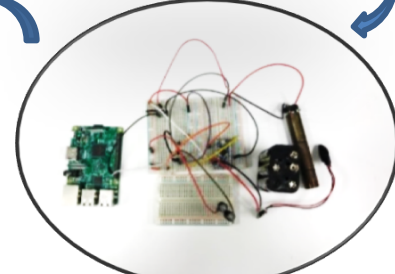
Future Material Testing



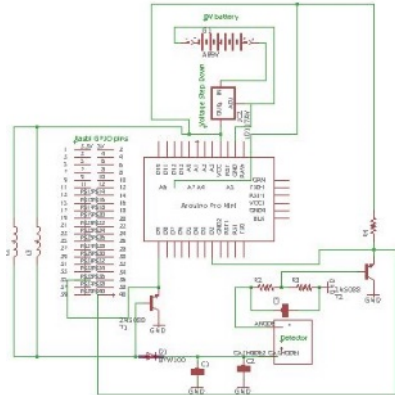
Future Assembly Design



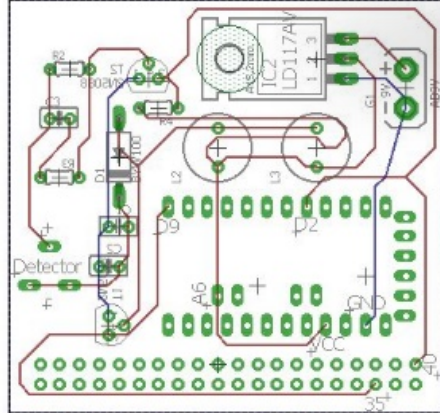
Current Design



Current Circuit Diagram



Current PCB Board Design



Current Circuit Parts List

Quantity	Item	Details
1	Raspberry Pi 3	With 32 GB SD card
18	wires	Not needed with PCB board
3	Breadboards	To be replaced with PCB board
1	Geiger Mueller Tube	Victoreen CDV700
1	Capacitor	330pF
2	Capacitor	10nF
1	High Speed Diode	UF4007
2	Inductor	15 mH
1	Transistor	STX0560
1	Transistor	2N4401
3	Resistor	1.5K
1	High Voltage Regulator	5V Regulator
1	Battery Pack	9V
1	Battery Terminal	9V
1	Microcontroller	Mini Arduino Pro
9	Batteries	AA

Future Work

- Complete and test circuit board
- Design and 3D print an ergonomic box
- Prepare materials for high school students
- Create software for wireless cellphone communication and data storage
- Design a mobile surveillance robotic platform
- Explore use of a drone (flying) platform
- Extend design to spectroscopic scintillators



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Consortium for Verification Technology

