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Automated Source-Detector Positioner for Radiation Detection

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Automated Source-Detector Positioner for Radiation Detection

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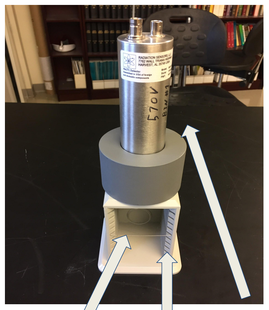
Customer Needs

The Nuclear Department has an unmet need for an automated source-detector positioner for radiation detection instruments. The requirements include zeroing a variety of sample types in the center of the detector and the capacity to automatically raise and lower the sample.

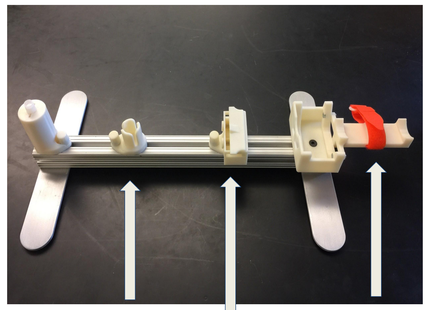
Current Procedure



Sample tray

Radiation detector

Shield holder slots



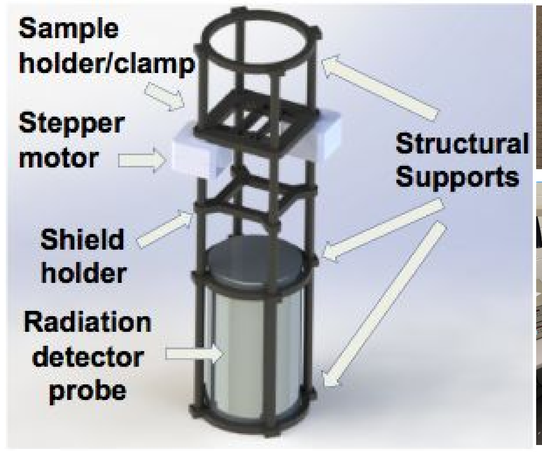
Sample holder

Shield holder

Radiation detector holder

The Nuclear Department at Virginia Commonwealth University currently utilizes two manual positioners for radiation samples, seen above. Neither of the present devices can operate within the large detector and require significan manual adjustments that are not preferable when dealing with radioactive samples. Collecting positional data over time also provides better correlations than discrete points.

The Design



Arduino controller

Radiation detector

Design Specifications

The final design consist of two linear motors to automatically adjust the height of the sample, three support rings to align the positioner around the detector, a spring based clamp for any sample, an arduino controller to autonomously control the motors, a universal shelf for shielding plates, and four steel rods to support the PLA frame.

Final Design

Due to the nature of the radiation detector not being able to receive a signal through the lead walls and not having any holes for wires, the motors have to be pre-programmed prior to data collection. Staying within the given budget required making the design as tight fitting around the detector as possible. The use of an autonomous drive system is important due to the isolation of the device. Although not included with the design image, the device will be run on an arduino Uno functioning in autonomous mode.

Cost Analysis

	Hybrid Linear Actuator	Arduino Uno w/Atmega328	Fully Threaded Rods (M5-1.0)	3D Printed Polylactide (PLA)	Stepper Motor Drive
Part Number	1568-1189-ND	1528-1073-ND	N/A	N/A	1528-1109-ND
Vendor Name	Digi-Key	Digi-Key	VCU Engineering	VCU Engineering	Digi-Key
Cost	$30.00	$65.00	$230.00	$12.00	$14.95
Contact Information	1-800-344-4539	1-800-344-4539	804-828-3925	804-828-3925	1-800-344-4539

In order to reduce the cost of the design we simplified the basic tasks it had to perform. Previous designs used large frames that were stable, but not optimized for the task we wished to perform. Our design builds around the detector while forming to it as closely as possible. We used two motors for stability and precision. The clamp does not need to be powered so we designed a spring-loaded clamp that can hold a variety of sample.

Future Improvements

Due to the nature of data collection, many different types of detectors and sample holders are used. Likely future improvements will include a more universal clamp or adapters for oddly shaped samples. Adapters for multiple detector types may also be designed. The use of linear motors to clamp on to the radiation samples would also be a future improvement. The use of PLA in the frame would ensured there wasn't much interference when collecting data. Other materials can also be used to guarantee less deterioration and deformation over time.