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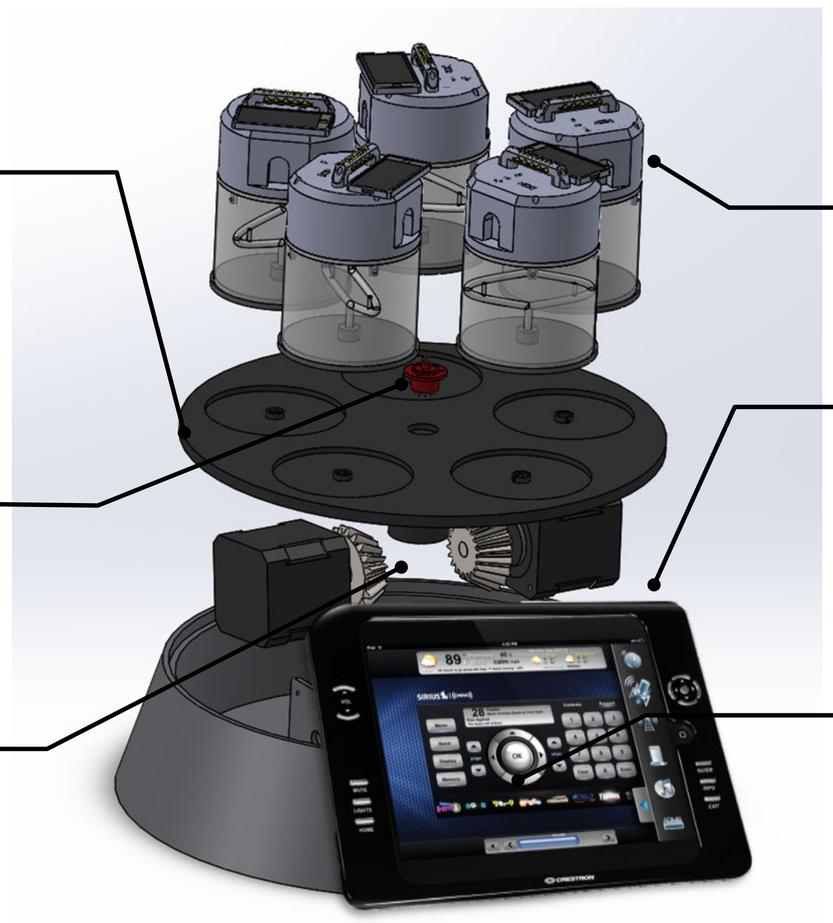
SYSTEM ARCHITECTURE AND DESIGN OF THE CENTRIFUGAL TENSIONED METASTABLE FLUID DETECTOR—CAROUSEL MODEL (CTMFD-C)

The CTMFD–C is designed for **vehicle-mounted and dismounted operations**, allowing emergency radiation responders to conduct **search and identification of Special Nuclear Materials (SNMs)**. This capability enables investigative operations to be conducted by (1) detecting whether such materials are present, (2) detecting the location (direction) of the radiation source, and (3) identifying the type of nuclear material.

Carousel System
The CTMFD-C consists of five TMFD Sensors on a rotating base plate; to provide a uniform exposure to a neutron source

Power / Data Port
Power and data is transmitted through the slip ring from the the sensors to the central processor.

Motor and Gearbox
The motor and gear box provides torque to rotate the carousel



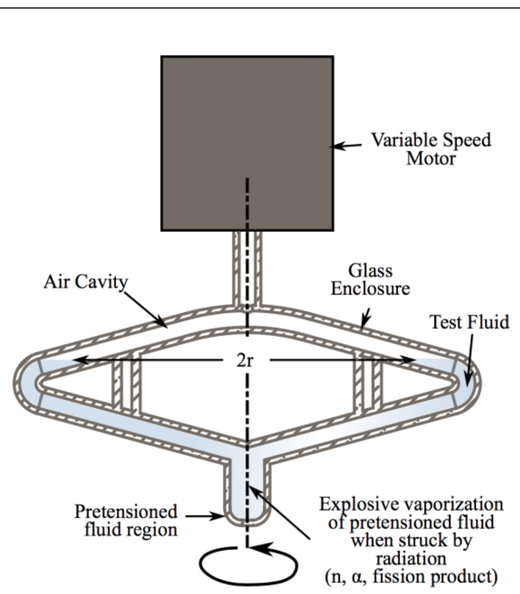
Sensor Units
Sensors operate at different rotational speeds to simultaneously identify different radioisotopes.

Central Processor
The central processor manages the run sequence for the system.

Main User Interface
The user interface outputs detection signal, direction and identity of the neutron source.

Figure 1. Physical Architecture of the CTMFD–C (Patent Pending).

This thesis discusses the system architecture of the CTMFD-C, a field-capable device to enable emergency radiation responders to conduct detection, search, and identification of special nuclear materials. This exploratory study expands the capability of commercial radiation detectors and aims to bridge the capability gaps faced by the military and homeland security forces in the defense against radiological weapons. The concept of the carousel system allows both vehicle-mounted and dismounted operations, allowing flexibility when conducting detection, search, and identification of illicit radiological materials that may be used or smuggled for terrorism and mass contamination. Through means of information fusion and mechanical integration, the system takes into account that the responder would be operating in an environment with an arbitrary neutron source and geometry with an unknown distance and direction to the source. The integrated system is designed to perform over a wide range of radiation fields and is able to conduct spectral identification of several signatures of special nuclear materials simultaneously. By reducing the time required to conduct spectral identification of an unknown neutron source, the responder's exposure to radiation is minimized in the operational "hot zone."



Working principle of the CTMFD in detecting SNMs

The motor and rotating arm rapidly spin a detection fluid in the glass bulb. The detector fluid is put in a metastable state, pending a convenient nucleation site such as an incident neutron particle.

In the presence of a neutron-emitting radiological environment, nucleation of nanoscale bubble cavities occurs, producing an audible sound and a visible flash.

Figure 2. Elements of a CTMFD sensor. Source: Taleyarkhan and Lapinskas (2013).

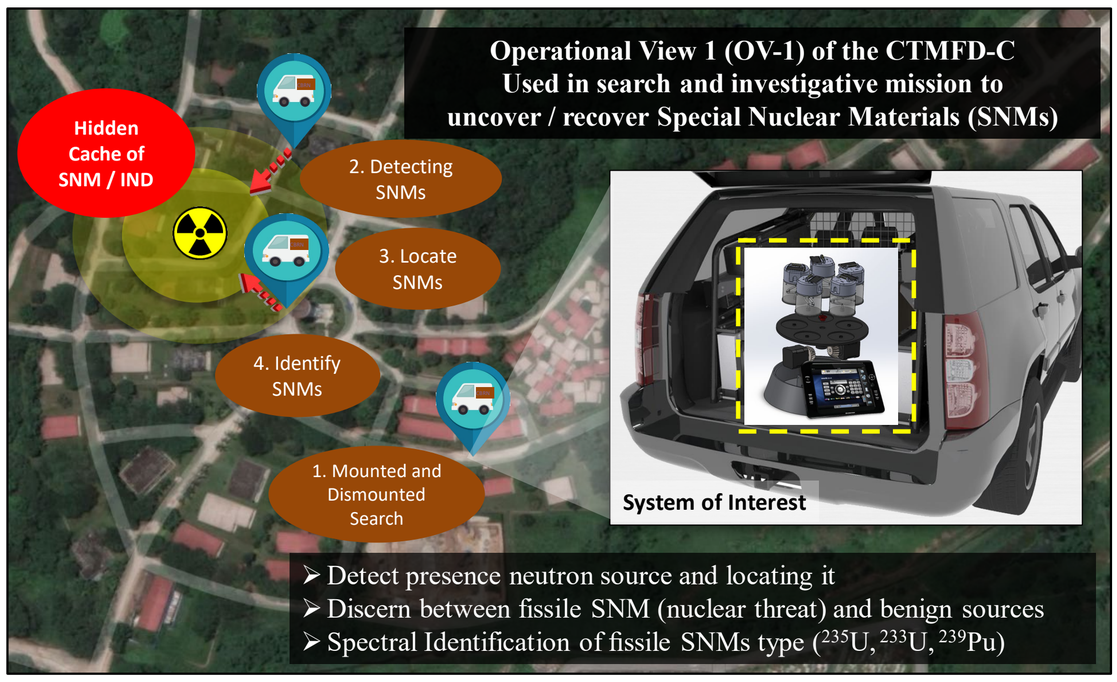


Figure 3. OV-1 of the CTMFD–C in the operating theater.

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