Understand Radiation Background for Better Threat Detection and Tracking

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MOTIVATION

- Threat of nuclear weapons use since the Cold War
- United States is not prepared for attack
- Early threat detection
- Utilizing a machine learning algorithm
- Find correlations between weather and natural background radiation measurements

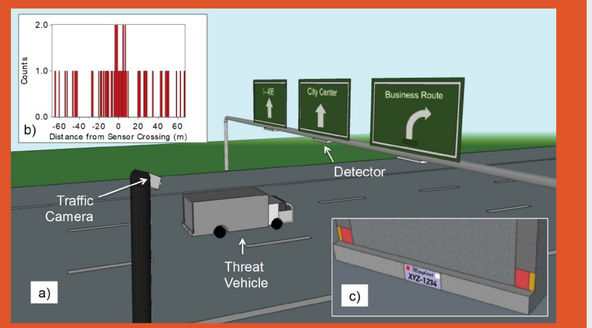

Fig. 1 A possible scenario of ground based traffic monitoring of radiation threats researched by homeland affairs: a possible application of this project.

METHODOLOGY

Using contextual sensors, a broad area sensing array will be created and deployed within the Oregon State University Campus. Upon determining a “pattern of life,”algorithms will be created from the data in correspondence with precipitation, weather patterns, and everyday operations.

Oregon State University

OBJECTIVE: **The project focuses on the study of background radiation so that it can be used in early threat detection and illegal radioactive material**

RESEARCH & EXPERIMENTAL DATA

DESIGN SELECTION

The design was selected based on the need of a sensor that would overcome all barriers that would interfere with its detection capability. A node based system is under construction. The sensor should inquire for a high and precise detection capability and include a Self-Taught Learning architecture that will collect data and conduct autocorrections.

DATA COLLECTED

- Ecogamma located outside of the TRIGA reactor collects background counts every 5 seconds
- Gamma gross count rate from EPA Radnet
- Background counts from Portland location
- Weather data from Corvallis weather station

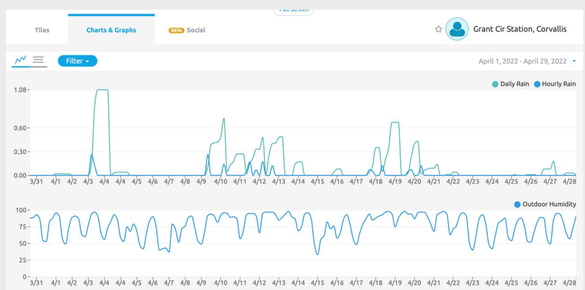

Fig. 2 Weather data over the month of April corresponding to dose rate from Ecogamma

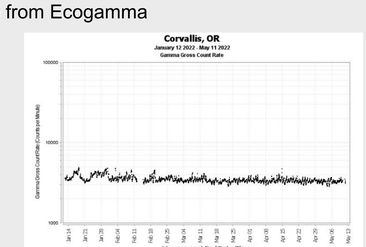

Fig. 3 Weather data from EPA Radnet

DETECTION RESULTS & ANALYSIS

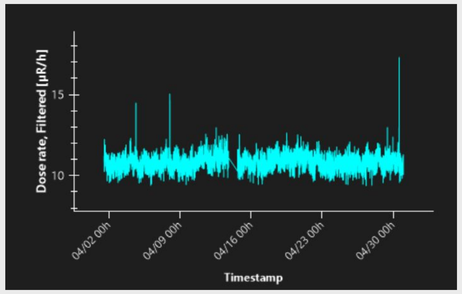

Fig. 4 Filtered Dose Rate over Time during April

Data over thirty days shows three peaks in dose rate. Following analysis with humidity, wind, precipitation, no association was found. Due to the location of the detector, peaks are likely due to transportation of radioactive materials and shed conditions. Peaks were still well below a dose rate concerning to the public.

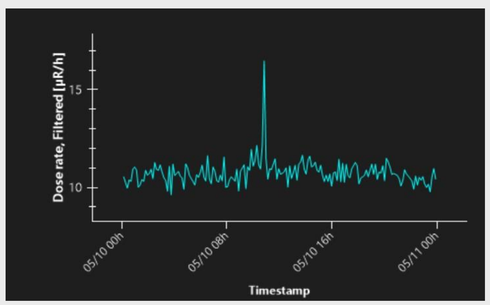

Fig. 5 Filtered Dose Rate over Time, 5/10

From a distance of 10 feet, there was an increase from 12.1 uR/hr to 16.4uR/hr from the source over 30 seconds. As the source was brought away from the detector, the counts decreased to the previous baseline of around 12 uR/hr. Through the experiment, it was determined that at a distance of 30ft, the detector no longer recognized the presence of the check source.

PROJECT CHALLENGES

- Data collection ranged from 8000 to 17000 data points a day
- Graphical representation unavailable for analysis
- Weather stations average value over wide span of location
- Predicted values in order to create algorithm were difficult to obtain given data
- Manual analysis derivation without algorithm made seeing associations difficult

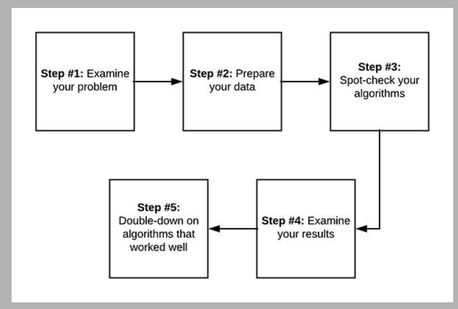

Fig. 6 Simplified steps to create a machine learning algorithm on Python

FUTURE DIRECTION

- Utilize expertise in coding to develop and validate algorithm
- Utilize algorithm to create graphical representations of data
- Demonstrate correlations between environmental factors and background measurements
- Obtain data regarding deliveries of other Radiation Center occurrences that could contribute to peaks in the data where weather may not be the influence.

Fig. 7 Environmental Gamma Radiation Monitor

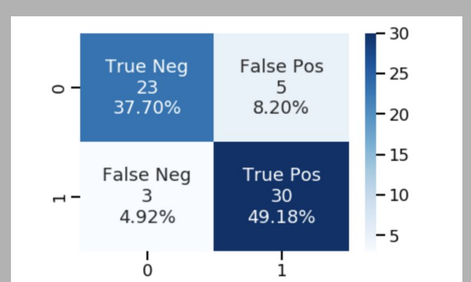

Fig. 8 Example of a confusion matrix to evaluate model algorithm