An AI powered tool for emergency services

Fire Sensor Radar Project

Martinez - Group 1

Meet the Team

Daniela Salazar

Electrical and Computer Engineering

Sameeha Boga

Computer Engineering and Computer Science

Daniel Fontaine

Electrical Engineering

Eve Mooney

Computer Engineering and Computer Science

Arya Goyal

Electrical Engineering

Natalia Wilson

Computer Engineering

Contents

1 Introduction

The Problem

- 4371 people passed away in building fires in 2023 - FEMA
- First responders dive into fires with no information
- Urban environments are crowded and confusing
- There is no efficient way of locating individuals currently

The Solution

ML Model

Models trained on thousands of scans

Dual Sensor Module

Radar and RealSense Camera system

Easy to Use UI

Accessible portal of data

Key Features

Point Cloud Mapping

Cluster mapping through radar and RealSense

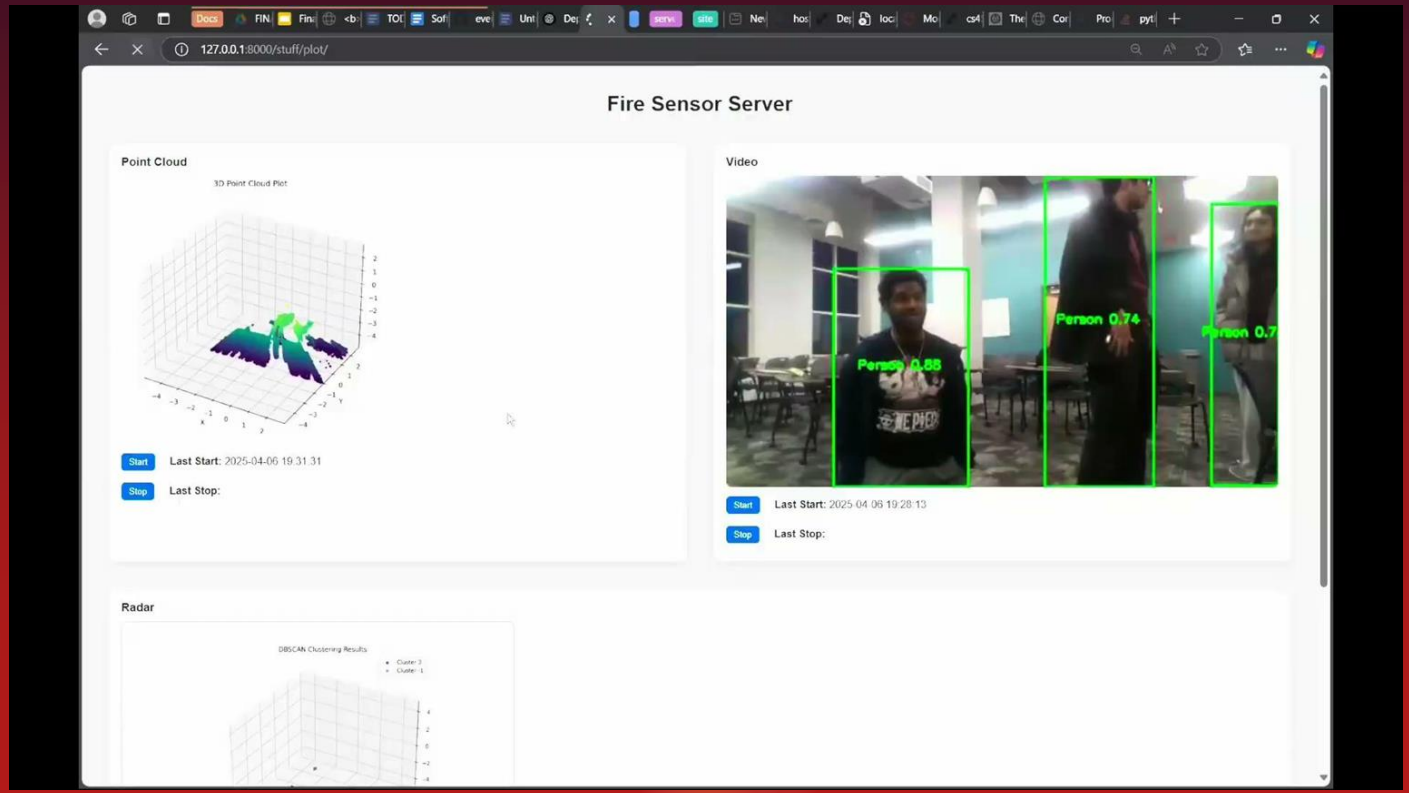
RealSense Detection

Optical sensing through RealSense

MMLab Models

Image processing by trained ML models

Demonstration



Implementation

Establish building and city contracts

Interlock emergency services with system

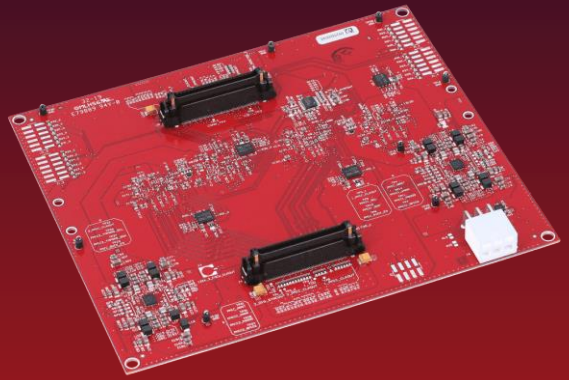
Attach a fixtures to rooms

Train agents in portal interface

2 Prototype

Layout

Dual Sensor Technology



Texas Instruments mmWave Cascading Radar

- Emits EM signals
- Captures reflected signals to map clusters

Intel RealSense Camera

- Records live visuals
- Identifies individual figures

Fire Resistant Casing

Openings for sensors

Lightweight

Throughholes for cables

Withstands

Key Characteristics

Equipment function at building voltage ratings

Operates at temperatures up to 284 degrees Fahrenheit

Weighs roughly 3 kilograms

3 Software

Assistant Algorithms

Roboflow

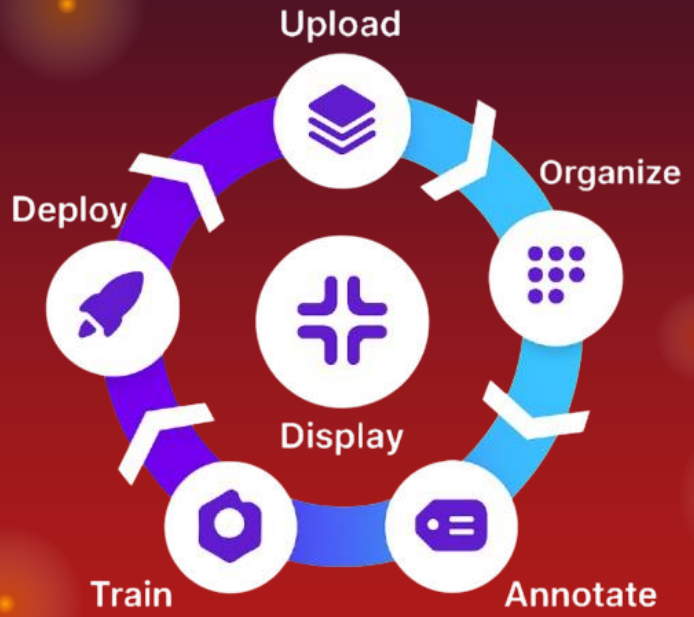
A machine learning platform used to streamline the process of developing AI models

DBscan

An algorithm used to partition data into clusters

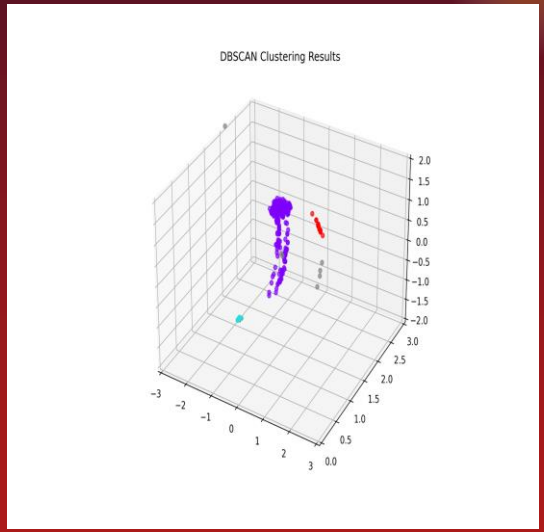
Training Datasets Roboflow

- Develop AI models for tasks like object detection, classification, and segmentation.
- Dataset of 8000 images
- Precision of 90.6%
- Recall of 87.9%
- mAP of 93.7%



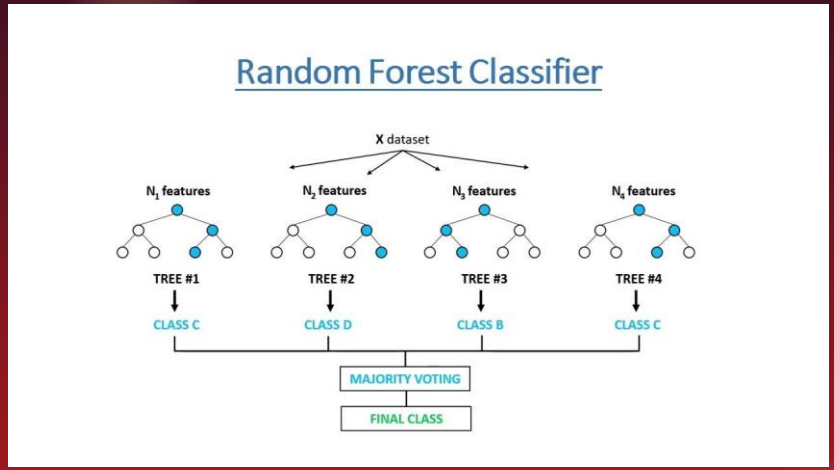
mmLabs

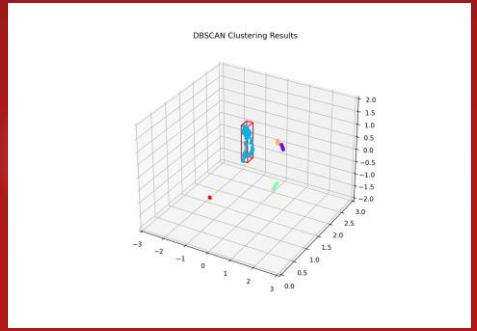
PyTorch Based	ML library for creating deep neural networks
3D Orientated	Specifically designed for 3D human recognition
MMCV	Library used for computer vision analysis
MMEngine	Library vital for training
Open Sourced	Easily editable and open to modifications

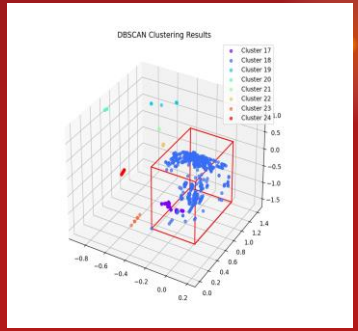


Training Datasets DBscan

- Trained using random forest classifier
- Scikit provided the RFC dataset
- Both models were trained using organized 3D models





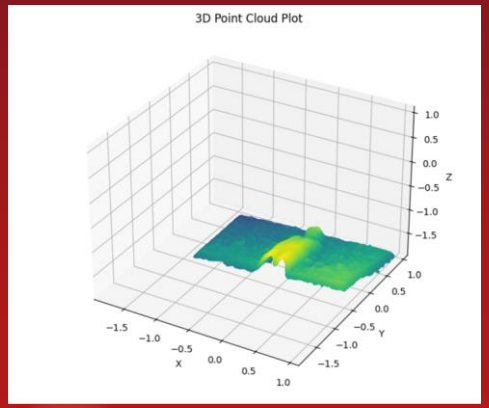


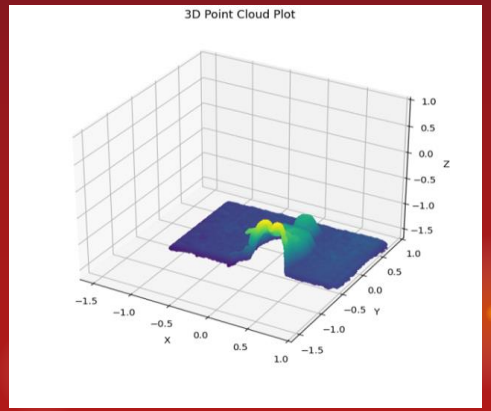
Pointcloud

3D Representation of the space

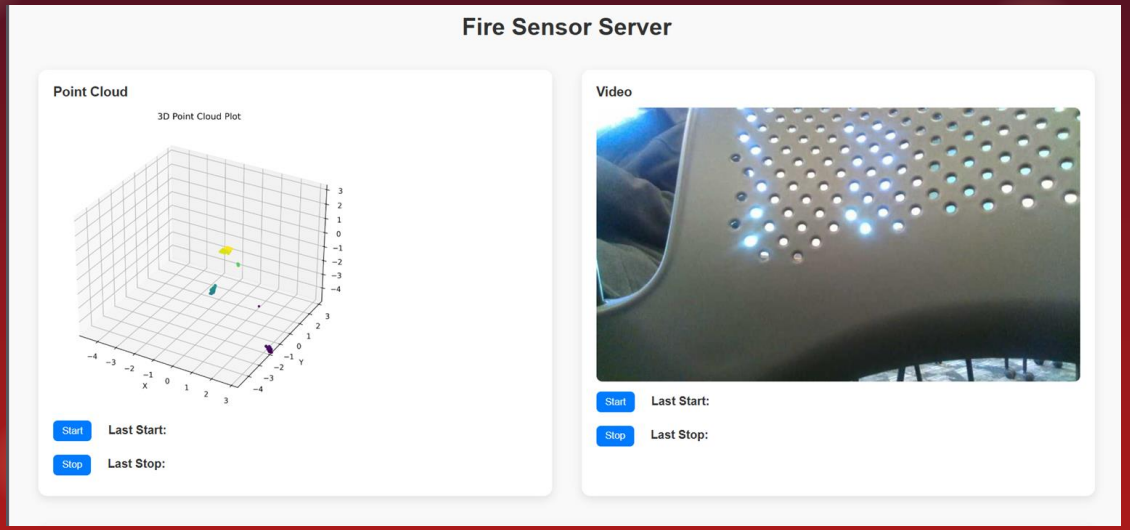
Points are made on the x, y, and z axises

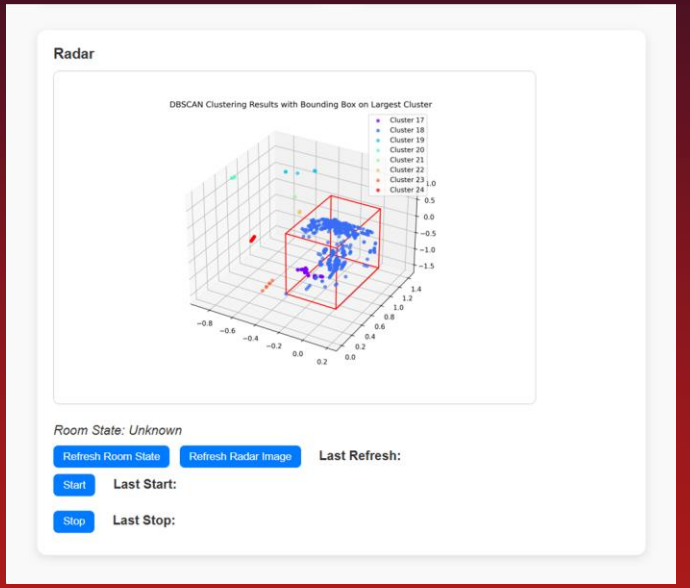
3D point coordinates are plotted into an Open3D Visualizer





Online Portal and UI



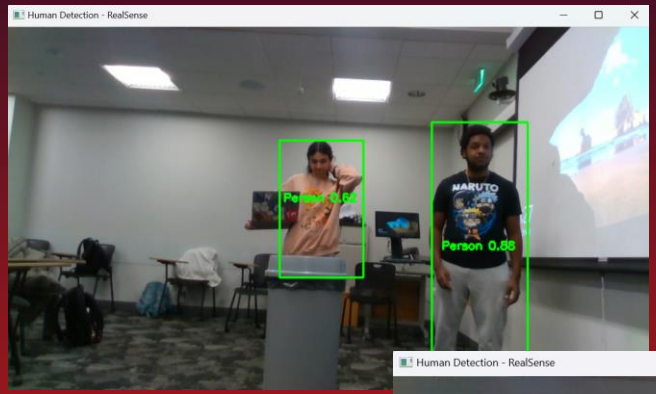


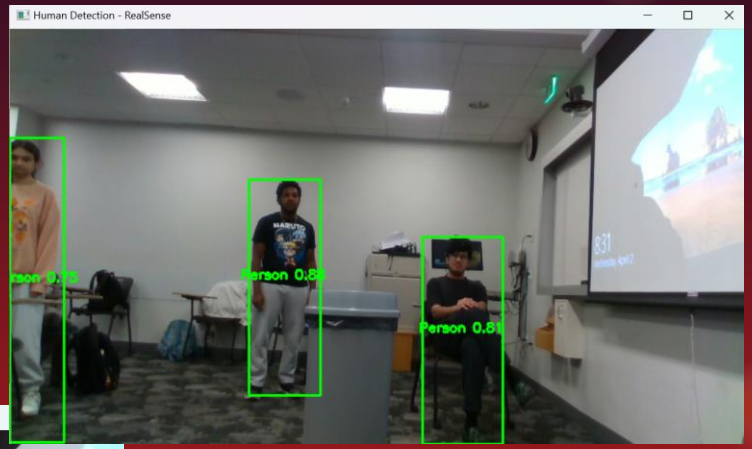
Jetson Orin Nano ⇄ EC2 instance ⇄ Django Site hosted on Render

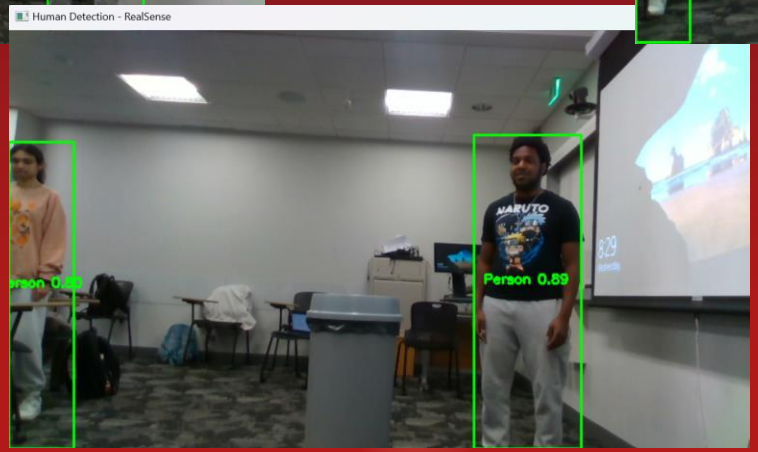
4 Testing

Testing Apparatus

Without Obfuscation

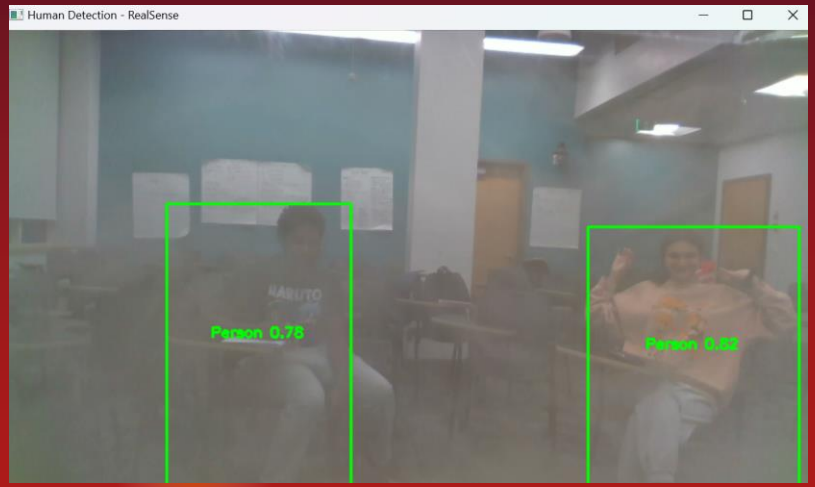




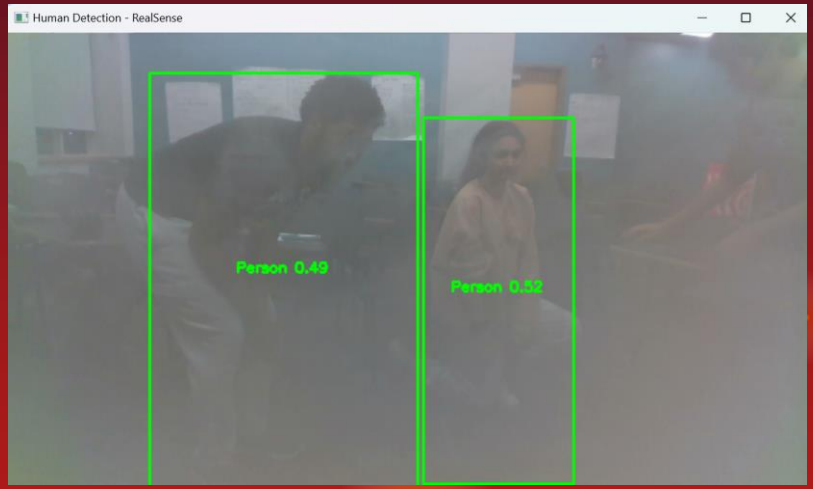


With Obfuscation

Heavy Smoke



Various Poses



Conclusions

High confidence in standing individuals

Subjects in poses were categorized less confidently

High performance

Subjects were easily recognized in reasonable conditions

Unexpectedly low drop in confidence

The highest drop in confidence was 14% and average to 9-10%

No change based on individual

Categorization confidence was unaffected by height, race, gender, etc.

5 Next Steps

Changes to Commercial Product

Wider dataset

Expanding scans to at least 100,000

Greater variety of people

Inclusivity of gender, race, and body shape

More dynamic samples

Specifically include people in different poses and positions

Better fire resistance

Use materials better suited for high temperature environments

Replace radar hardware

Update the sensor to a higher end model

Quicker run time

Make scans and identification instantaneous

Thank You!

Special thanks to Chang Wang and Professor Martinez-Lorenzo

Questions?