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- **Problem Statement** -The project aims to detect and classify drones, cars, and people using Doppler radar data, leveraging convolutional neural networks (CNNs). With the increasing use of drones in various industries, the need for reliable detection systems is critical.

- **Motivation** - Beyond military use, the growing prevalence of drones in commercial sectors, such as surveillance, delivery, and infrastructure inspection creates an urgent need for reliable detection systems. Effective classification of drones, cars, and people from radar data can enhance security, safety, and operational efficiency. This project aims to contribute to this need by developing a robust, automated classification system using state-of-the-art deep learning techniques.

- **Challenges** -
    - **Signal Variability**: Differentiating targets is challenging due to varying radar signals from drones, cars, and people.
    - **Data Imbalance**: Fewer drone samples may lead to biased classification.
    - **Complex Feature Extraction**: Extracting key features from radar signals requires computationally intensive models.

- **Data Requirement** -To develop a solution, we require high-quality labeled Doppler radar data with sufficient variability in movement and radar signatures for drones, cars, and people. We plan to use the dataset provided by the RAD-DAR radar system.The dataset includes over 17,000 labeled samples captured using an FMCW radar system at 8.75 GHz with a maximum bandwidth of 500 MHz
    - Reference research paper for how data was collected is https://ietresearch.onlinelibrary.wiley.com/doi/10.1049/iet-rsn.2019.0307

- **Techniques/Algorithms** -In this project, we will do a three-way classification (drone, car, and person) from Doppler radar data. For performing classification we will be looking at convolution neural network-based approaches.CNNs will be used to process the radar spectrograms, as they are highly effective in identifying spatial patterns. They can capture frequency and temporal information from the radar data, aiding in classification between drones, cars, and people

- **Evaluation** -
    - **Accuracy & F1-Score:** Measure overall performance and balance between precision and recall, handling class imbalances.
    - **Confusion Matrix & ROC-AUC:** Identify misclassifications and assess model discrimination between classes.
    - **Cross-Validation:** Ensure generalizability and prevent overfitting with k-fold validation.

- **Impact** -
    - **Enhanced Drone Detection:** Improve the accuracy and reliability of automated systems for distinguishing drones from other objects, crucial for security.
    - **Broader Applicability:** Provide a scalable radar-based classification model that can be adapted for various real-world applications like infrastructure monitoring, etc.

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