Precision Detection for Seamless Protection

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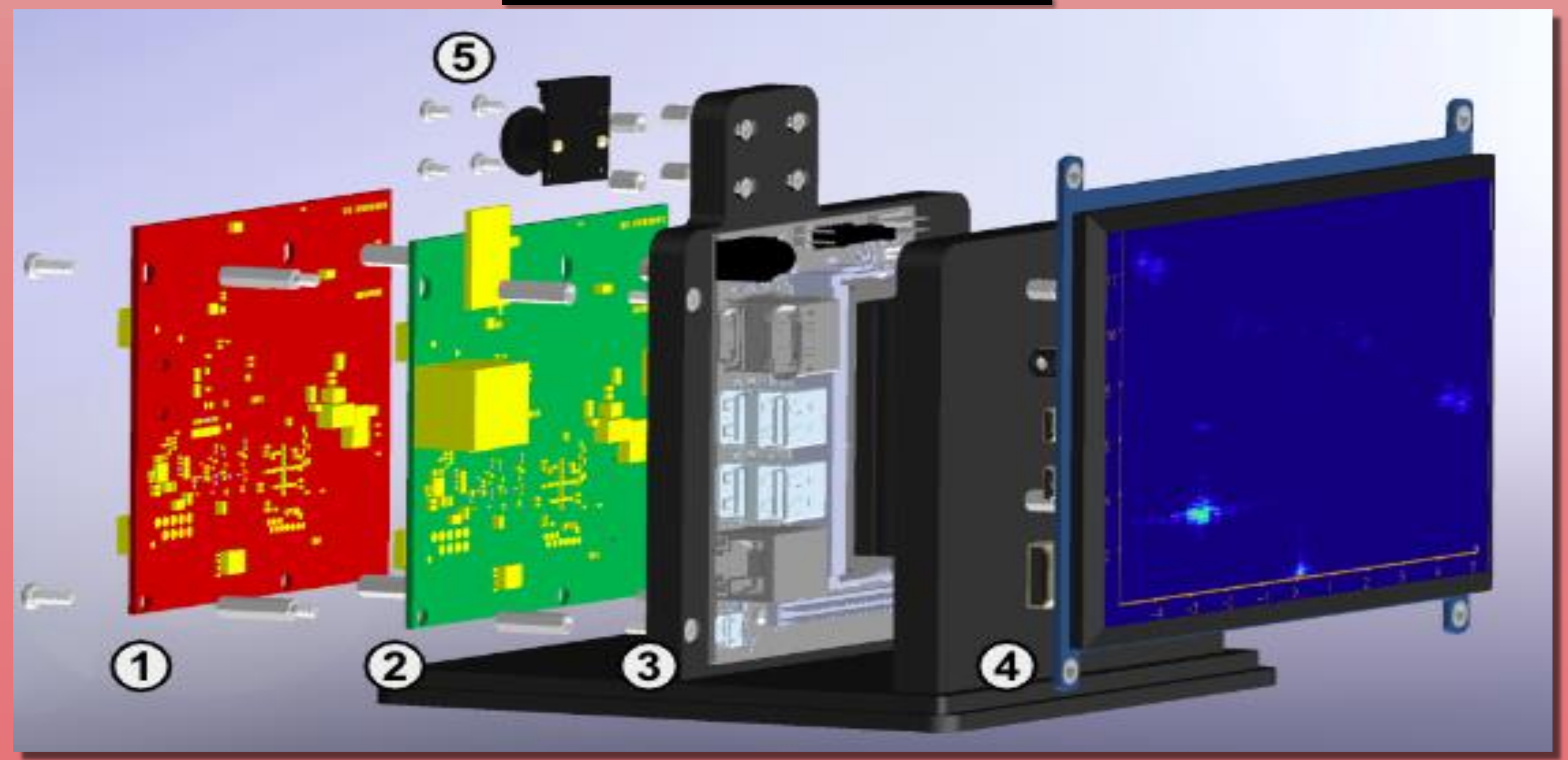
Background

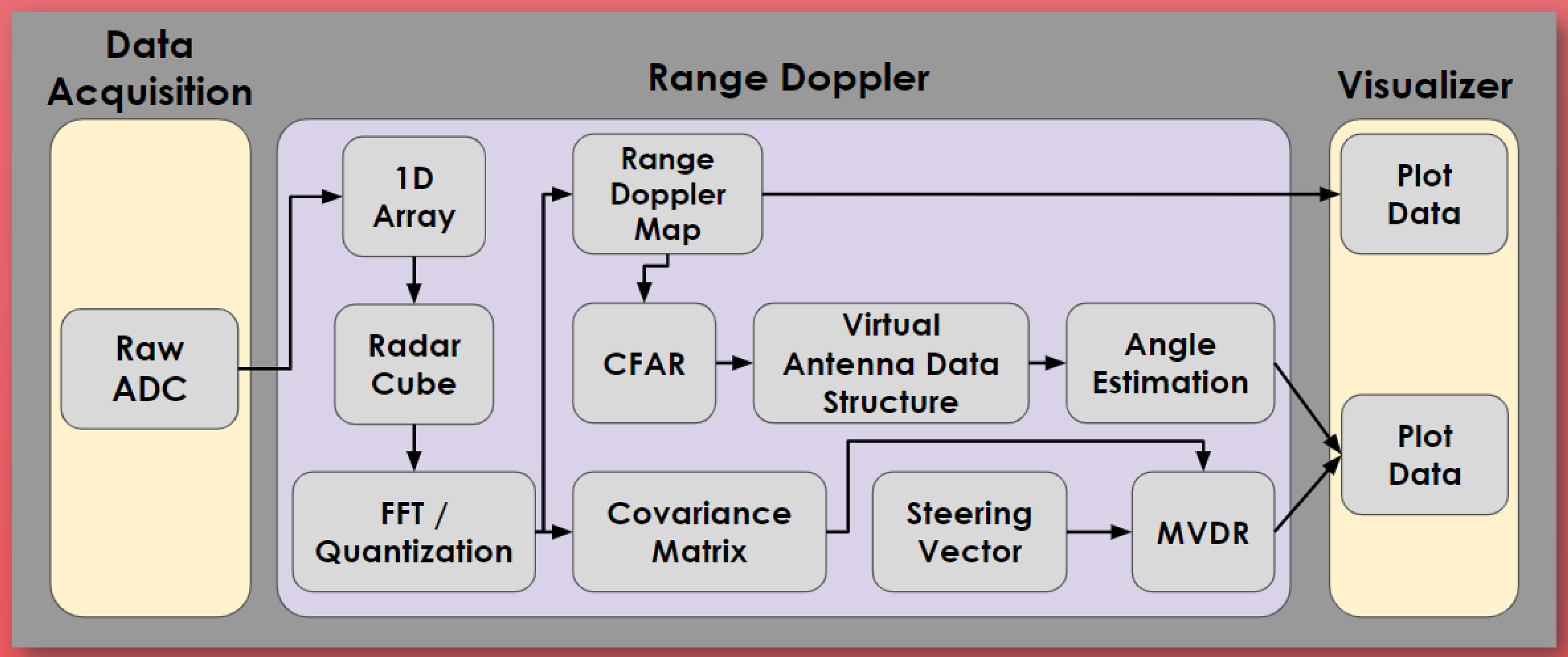
In today's automotive landscape, vehicles are equipped with advanced technology to enhance passenger safety. Millimeter wave radar can detect objects through rain, snow, and fog, but struggles in dense environments with impaired sightlines. To improve robustness, sensors can be integrated into a distributed network.

We demonstrate sensor fusion using a USB camera and a Texas Instruments MIMO radar board. Computer vision techniques enable real-time object detection, with radar data superimposed onto the camera feed. Object tracking is then performed using a multi-node system with two radar nodes and an external server.

Radar Node

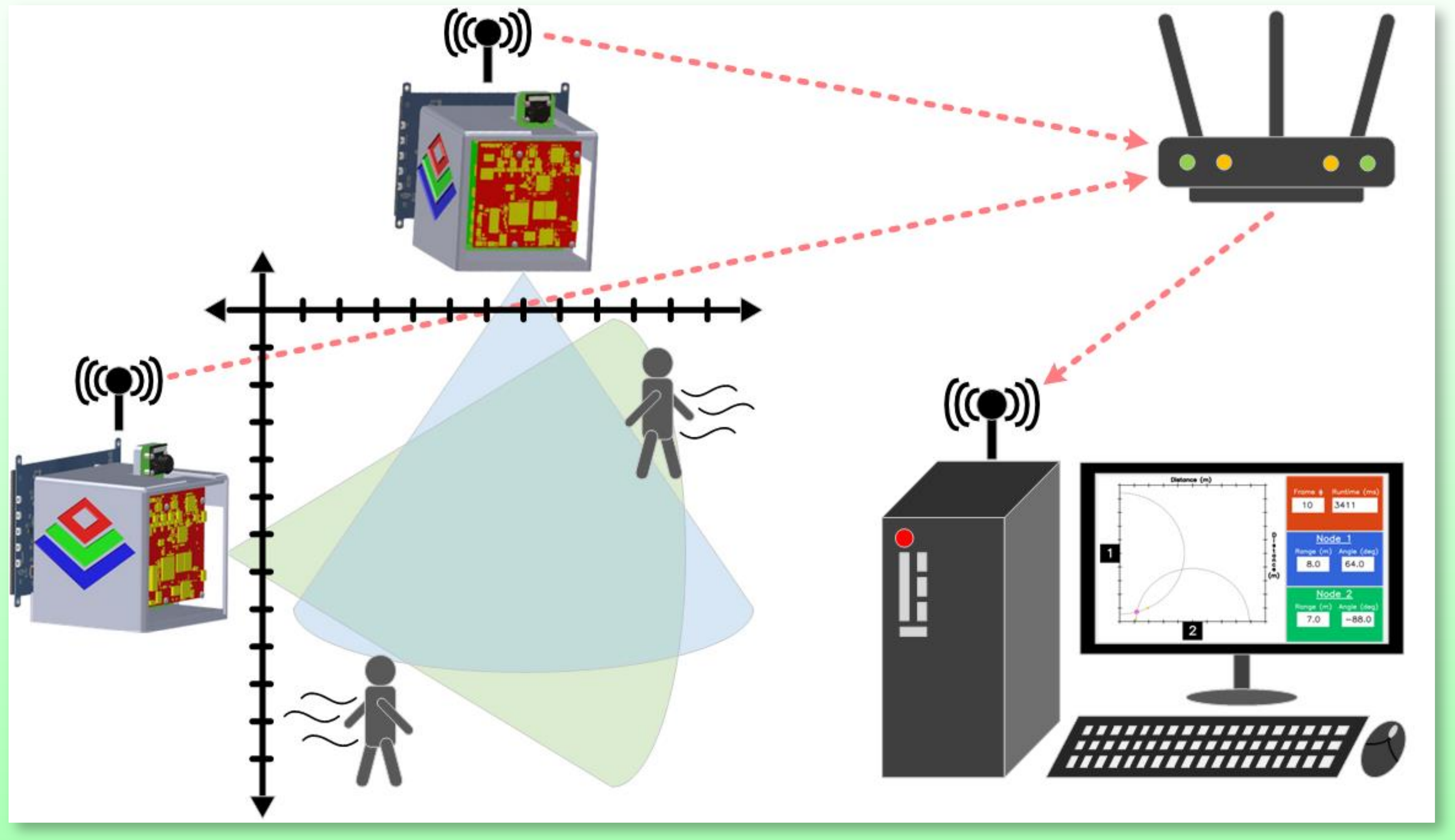


① Texas Instruments AWR2243BOOST
② Texas Instruments DCA1000EVM
③ NVIDIA Jetson Nano
④ LCD Touchscreen Display
⑤ CSI Camera



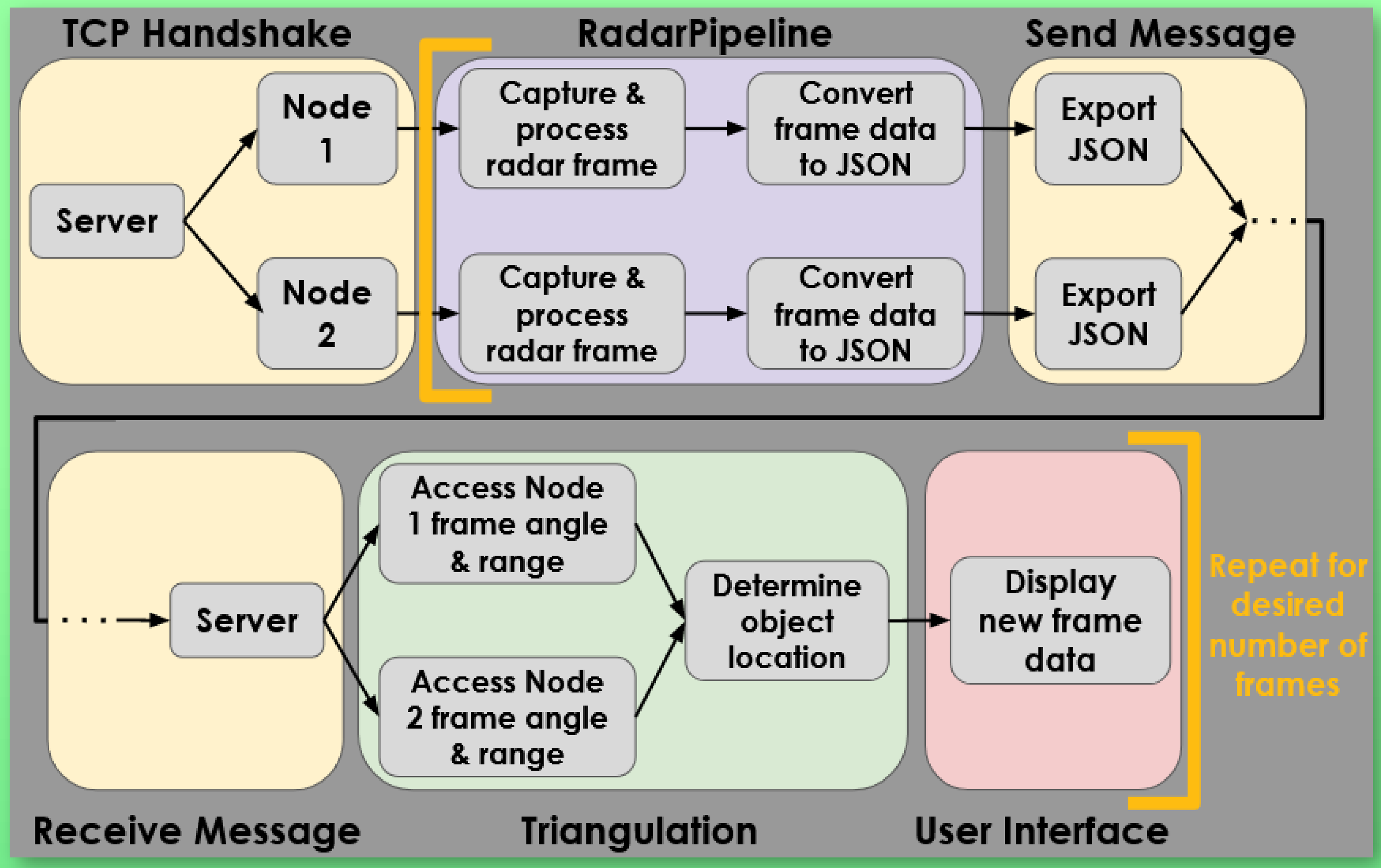
1. Single Radar Node Block Diagram

Distributed Radar Network



2. Distributed Radar Network Setup

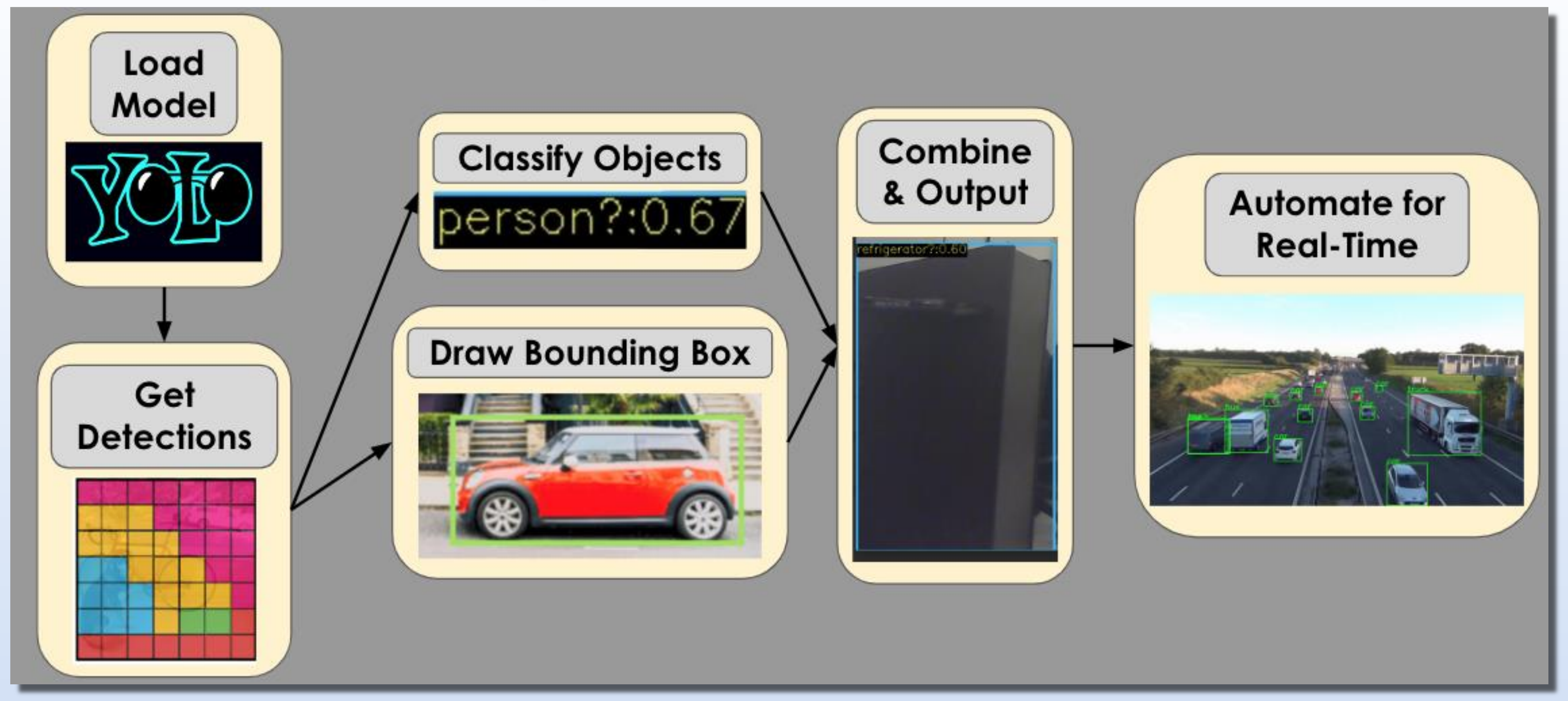
The distributed network system comprises of two radar nodes on perpendicular sides of the testing space. Each node detects an object moving within the test space and sends radar frame data to an external server over a shared Wi-Fi network (TCP client socket). Upon receiving frame data (TCP server socket), our Python-based visualizer executes object localization algorithms and displays the object's location in our user interface. This process is repeated for each frame in the test.



3. Distributed Radar Network Block Diagram

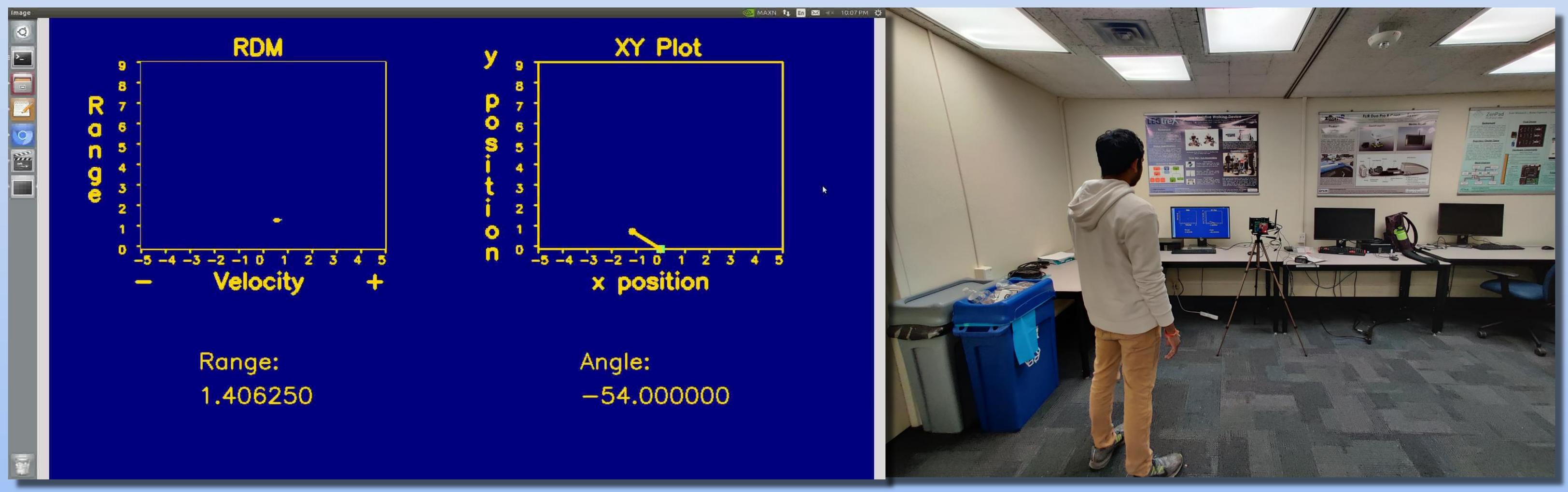
GitHub SCAN ME

Object Detection



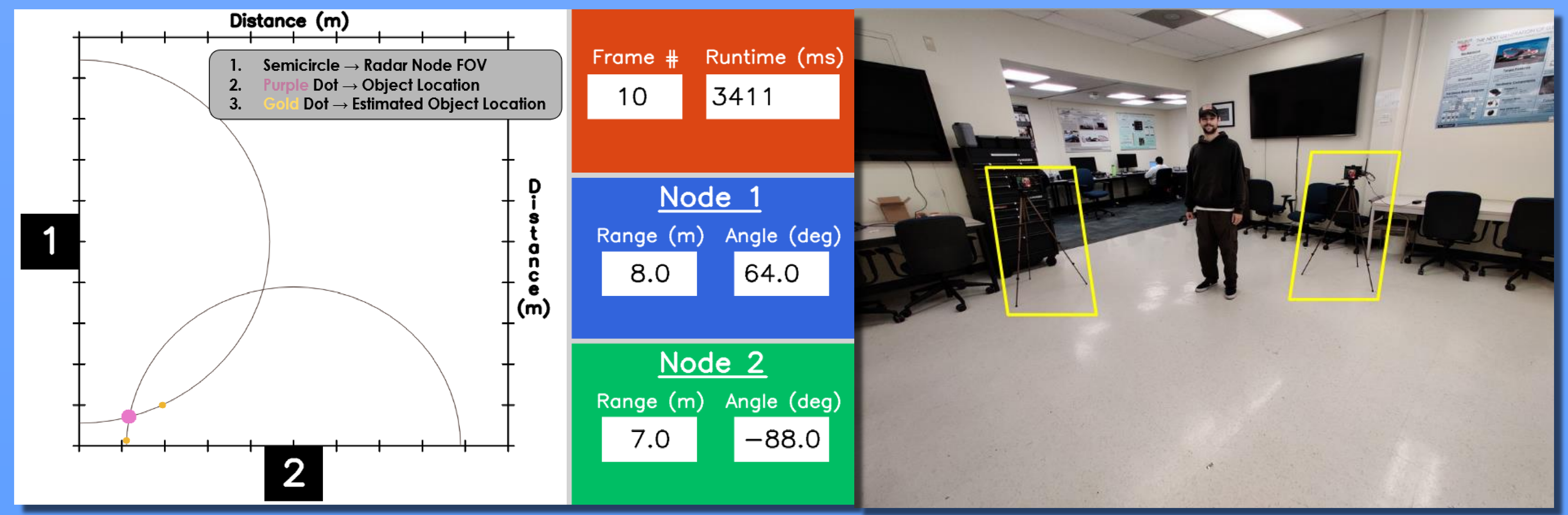
4. Real-Time Object Detection Block Diagram

Single Radar Node Test



Single node visualizer (left) displays real-time radar data through a Range Doppler map, which plots radial distance versus velocity, and an X-Y plot that translates the detected object onto a 2D coordinate map. A test subject (right) moves within the field of view of our radar node.

Distributed Network Test



Distributed network visualizer (left) displays updated real-time object location along with radar node data. A test subject (right) moves within the field of view of our two radar nodes (yellow outlines).

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