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(57) Abstract :
Proactive railway automation and safety system The invention relates to a decentralized railway safety system integrating trackside sensing, edge processing, direct locomotive intervention and airborne obstacle removal. Multi-modal ultrasonic and infrared sensors monitor main-line and loop-line track regions. A local edge controller evaluates sensor data, obtains obstruction coordinates from a positioning receiver and transmits a hazard payload over a peer-to-peer wireless link without cloud routing. An onboard locomotive receiver responds to the payload by executing an interrupt routine for propulsion override and train deceleration. In parallel, a multi-rotor aerial platform travels to the obstruction site and uses a multi-axis robotic manipulator with a gripper to remove the obstruction. A diagnostic workstation receives live video and telemetry and performs object detection in a background processing thread independently of the operator-interface thread. The system provides low-latency hazard response and physical track clearance for railway sections including remote or off-grid locations.

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