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TITLE PAGE

- **Problem Statement ID : 1566**
- **Problem Statement Title : Enhancing Body Detection in CSSR operations using Advanced Technology**
- **Theme : Disaster Management**
- **PS Category : Hardware**
- **Team ID :**
- **Team Name : Niriksan**

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EMI and ER on a drone for CSSR

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Our solution is a dual-method detection system for locating human bodies buried under rubble in disaster scenarios. It combines Electromagnetic Interference (EMI) technology with Electrical Resistivity Tomography (ERT) in a two-stage approach, deployed via a specialized drone:

1. Stage 1 - Broad Area Scan: A drone equipped with EMI sensors flies over the disaster area, detecting anomalies in the electromagnetic field due to the higher conductivity of human bodies that could indicate their presence.
2. Stage 2 - Focused Analysis: When the EMI scan flags a potential location, the drone deploys a probe for ERT measurements. This provides a more detailed analysis of the electrical properties of the subsurface, confirming the presence of a body.

This solution addresses the critical challenge of quickly and accurately locating survivors in disaster scenarios:

1. Speed: The drone-based EMI scan can cover large areas rapidly, crucial in time-sensitive rescue operations.
2. Accuracy: The two-stage approach reduces false positives.
3. Penetration: The system can detect bodies at depths that will be challenging otherwise, especially with high moisture.
4. Automation: By focusing on the specific electrical properties of human bodies, the system can be automated easily.

This solution is unique and innovative since it uses:

1. Dual-Method Approach: The combination of EMI and ERT is novel, leveraging the strengths of both technologies.
2. Drone Deployment: Using a drone for initial scanning and targeted probe deployment is innovative.
3. Human-Specific Detection: Unlike other subsurface imaging tools, it is tailored specifically for detecting human bodies.
4. Adaptive Technology: The system can adjust its parameters based on the specific conditions of each disaster site.

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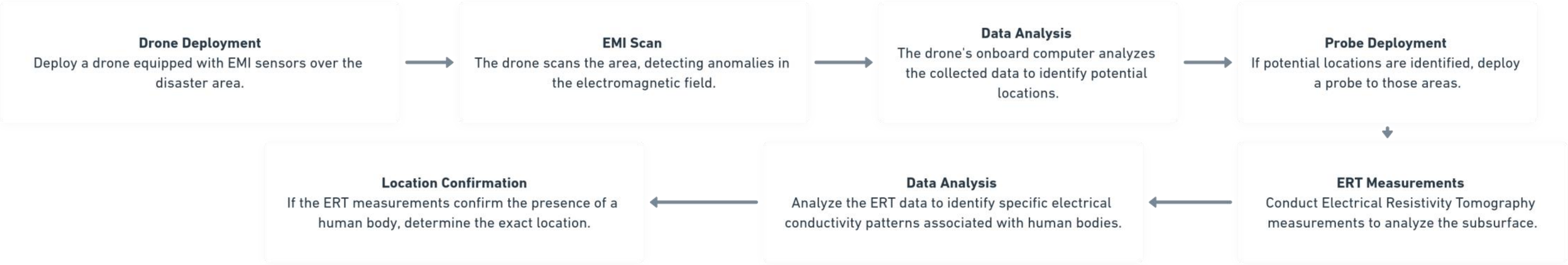
TECHNICAL APPROACH

1. Hardware:
    1. Drone: Custom-designed quadcopter with high payload capacity and stability
    2. EMI Sensors: Advanced electromagnetic interference detection array
    3. ERT Probes: Deployable electrical resistivity tomography sensors
    4. Onboard Computer: High-performance, low-power embedded system (e.g., NVIDIA Jetson)
    5. GPS Module: For precise location tracking
    6. Communication Module: Long-range, high-bandwidth data transmission (e.g., 5G/LTE)
2. Software:
    1. Programming Languages: • Python: For main data processing and machine learning algorithms • C: For low-level hardware control and real-time processing
    2. Frameworks: • TensorFlow or PyTorch: For machine learning and signal processing • ROS (Robot Operating System): For drone control and sensor integration • OpenCV: For any additional visual processing
    3. Data Visualization: Matplotlib or Plotly for real-time data representation
3. User Interface:
    1. Web-based dashboard using React.js
    2. Mobile app using React Native or Flutter for on-field access.



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FEASIBILITY AND VIABILITY

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Feasibility:

1.Technical Feasibility: The core technologies (EMI and ERT) are well-established in other applications, making adaptation easy.
2.Operational Feasibility: Drone technology is mature enough to support this application, and the two-stage approach aligns well.
3.Economic Feasibility: More affordable than other methods like GPR and image processing.

Potential challenges and risks

1.Signal Penetration: Dense rubble may limit the depth at which bodies can be detected.
2.Environmental Interference: Varying moisture levels, temperature, and debris composition could affect measurement accuracy.
3.False Positives: Distinguishing human bodies from other conductive materials in rubble could be challenging.
4.Drone Operation: Unstable structures and unpredictable weather in disaster zones may impede drone flight and landing.

Strategies for overcoming these challenges

1.Advanced Signal Processing: Implement ML algorithms to enhance signal processing, improving depth penetration and accuracy.
2.Adaptive Sensing: Develop sensors that can automatically calibrate based on environmental conditions.
3.Multi-Sensor Fusion: Integrate additional sensors (e.g., infrared, acoustic) to cross-validate detections and reduce false positives.
4.Robust Drone Design: Engineer drones with advanced stabilization and obstacle avoidance for operation in challenging environments.

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IMPACT AND BENEFITS

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Potential impact on the target audience

1.Disaster Victims:

1. Increased chances of survival due to faster location and rescue
2. Reduced suffering time while trapped under rubble
3. Higher probability of being found, even in challenging environments

2.Search and Rescue Teams:

1. Enhanced efficiency in locating victims
2. Reduced physical strain and risk by minimizing unnecessary excavation
3. Improved resource allocation based on more accurate victim location data
4. Increased morale due to more successful rescue operations.

Benefits of the solution

1. Saves lives by improving the speed and accuracy of victim location
2. Lowers the cost of prolonged search and rescue operations
3. Minimizes unnecessary excavation, reducing environmental disturbance in disaster sites
4. Lower fuel consumption compared to traditional heavy machinery-based search methods
5. Potential for use in environmental disaster scenarios (e.g., locating animals after natural disasters)
6. Potential spin-off technologies for other applications (e.g., non-invasive medical imaging)
7. Improves the safety of rescue workers by reducing exposure to unstable structures

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RESEARCH AND REFERENCES

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12. PyGimli, An open-source library for geophysical modeling and inversion.