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IV SEMESTER – MCA491P Major Project
LoRa-Based Location Tracking and Fall Detection System

Synopsis

The exploration of India's remote hills, dense forests, and mountainous terrain offers adventure while simultaneously presenting significant safety concerns. Approximately 70% of these isolated regions lack mobile network coverage, Wi-Fi connectivity, or any reliable means of communication during emergencies. Trekkers face substantial risks including disorientation, physical injury from falls, and medical emergencies often without access to emergency response services. To address these critical safety gaps, a LoRa-based location approximation and fall detection system will be developed specifically for off-grid trekking environments. This solution leverages long-range, low-power radio technology capable of maintaining connectivity across distances of 10-15 kilometers, ensuring trekkers remain connected with their expedition group and can transmit emergency signals without dependence on cellular or internet infrastructure. With an estimated 15 million individuals participating annually in trekking and adventure tourism activities throughout India, and the sector experiencing robust growth at a CAGR exceeding 17%, there exists a pressing demand for a reliable, offline safety solution that provides real-time alerts.

The device designed for trekkers will use ESP32 microcontroller paired with a LoRa module, running lightweight Python scripts to enable simple and reliable communication between devices. Each wearable is send out small data packets at regular intervals and any detected falls. Fall detection will be managed directly on the device using motion sensors like an accelerometer and gyroscope, allowing it to raise an alert quickly if something goes wrong. Operating fully offline, the system won't require GPS, Wi-Fi, or mobile networks. Instead, it estimate the trekker's location using signal strength (RSSI) received by other ESP32+LoRa nodes positioned at known fixed locations. These nodes will collaborate to determine the source of the signal using trilateration. The gathered information can then be transmitted to a mobile device or local interface via Bluetooth or Wi-Fi and displayed through a user-friendly interface built with React Native and Next.js.

The expected outcomes of this project is to provide trekkers with a safer, more confident, and well-connected trekking experience. The system will enable real-time alerts in the event of a fall or if a trekker goes missing, ensuring timely response even in remote, disconnected environments. It will also record each trekker's movement using location approximation techniques, allowing for post-trek analysis and improved planning for future expeditions. Designed to be lightweight, energy-efficient, and fully independent of mobile networks or internet access, the solution is well-suited for extended treks through challenging terrain. Ultimately, the project aims to enhance safety, preparedness, and peace of mind for both trekkers and their families, especially in areas where traditional communication and rescue options are limited.

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