LifeBridge – One Pager
Developers – Nitzan Jarus, Firas Shehady and Bara Haj

1. Background and Academic / Industrial Challenges

Home-based health monitoring is becoming increasingly common due to the availability of affordable wearable devices. Despite this, many commercial systems rely heavily on cloud connectivity, subscription models, and complex smartphone applications that do not meet the needs of elderly users or individuals with technological accessibility limitations. This has created a significant gap between modern sensing capabilities and the usability required by the users who depend on them most.

The market is also saturated with low-quality or misleading fall-detection products that fail under real-world conditions. In one case personally experienced by a team member, a commercial "panic button" device failed to trigger during an emergency—leaving an elderly user unattended for several minutes. Such failures demonstrate the ethical and technical importance of designing reliable anomaly-detection systems where lives may depend on timely and accurate alerts.

These challenges emphasize the need for a trustworthy, locally operating solution that minimizes external dependencies, improves accessibility, and ensures user privacy through on-device data processing.

2. The Challenge (Academic and Industrial)

Developing a dependable fall-detection and activity-classification system requires addressing several multi-disciplinary challenges:

Latency and Reliability

Cloud-dependent systems introduce communication delays and may stop functioning during connectivity loss—an unacceptable risk for time-critical anomaly detection.

Edge Processing Constraints

Running classification and anomaly-detection logic locally requires efficient and lightweight algorithms capable of real-time execution on constrained hardware while maintaining accuracy and minimizing false positives.

Privacy and Data Sensitivity

Continuous motion data may reveal sensitive behavioral patterns. Offloading such data to external servers increases privacy risks, making on-device processing essential.

Accessibility Challenges

Many elderly users cannot reliably operate or configure complex devices or smartphone applications. A practical system must require minimal interaction, function autonomously, and present information through a clear and intuitive interface.

3. Key Engineering and Technological Aspects

Edge Data Processing Module (Python)
A Python module simulates accelerometer-based motion patterns (resting, walking, sudden impact) and processes them locally to maintain low latency and preserve privacy.
Anomaly Detection Engine
Statistical and rule-based models evaluate acceleration spikes, impact signatures, and post-event inactivity to identify potential fall events with balanced sensitivity.
User Interface & Visualization Layer
A lightweight dashboard (HTML/JS, Flask, or Streamlit) presents real-time activity status, motion graphs, and alert indicators. The UI emphasizes clarity, accessibility, and minimal required user interaction.
Optional Local Data Storage
A lightweight local database (e.g., embedded DB or MongoDB) may record short-term history and detected events. All recorded data remains on the device, ensuring privacy and offline functionality.

4. Scope

The project delivers a functional prototype consisting of:

1. a simulated motion-generation module,
2. an on-device fall-detection engine, and
3. an accessible dashboard for real-time visualization and alerts.

The system operates entirely on local hardware without cloud processing, remote APIs, or full wearable-device integration. It is not intended as a clinical-grade diagnostic tool, but rather as a focused demonstration of reliable, privacy-preserving, and accessible edge-computing techniques for home-health monitoring.