Privacy Governance-Driven Design of AI-Powered Elderly Safety Monitoring for Cambodia

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Purpose – This design study demonstrates how privacy governance can inform architectural decisions from inception rather than being retrofitted post-deployment, preserving privacy in elderly safety monitoring and enforcing data protection, while maintaining cost-effectiveness in Cambodia.

Design/methodology/approach – The study validates technical feasibility and cost-effectiveness, using edge-based pipeline comprising four NIR cameras with 850nm IR and an NVIDIA Jetson Orin Nano edge computing platform, on 20 commercial video footages, following this chronological approach: 1) Integrating YOLOv8n for person detection, defining the Region of Interest (ROI); 2) Converting the ROI to skeletal coordinates using MediaPipe, representing the 17 body keypoints in COCO format; 3) Storing the skeletal coordinates (only); 4) Permanent deletion of original footage; 5) Incident classification using a hybrid CNN+LSTM+Transformer architecture.

Findings – Validating the 20 footages demonstrates 91.3% keypoint detection with 20.53FPS processing speed, confirming 24/7 monitoring capability without facial recognition. Cost analysis shows 3-year total cost reduction by 61% compared to cloud alternatives, achieving breakeven at month 13.

Practical Implications/Limitations – The architecture expands market accessibility to 168,000-252,000 middle-income urban elderly (8-12% of Cambodia's elderly) by 2030. Limitations include no validation on benchmark datasets and pending hardware testing on actual Jetson Orin Nano deployment.

Originality/value – The study demonstrates that privacy-first architectural design yields economic co-benefits, contributing empirical evidence that governance principles can drive technical architecture while maintaining efficiency and cost-effectiveness in healthcare AI for Cambodia.

Keywords: Privacy governance, Edge computing, Elderly safety monitoring, Privacy-by-design, Developing countries

Paper type: Case Study