AI-Enabled Mobile Financial Services on RISC-V for Wireless Communication

INTRODUCTION

Lesotho, a landlocked country in Southern Africa, has made significant strides in developing its telecommunications sector, with major mobile operators like Vodacom Lesotho and Econet Telecom Lesotho providing services to its population. Mobile phones have become essential tools for communication, access to information, and economic opportunities. However, rural areas (and the population in general) still face challenges in adopting and utilizing mobile technology due to high costs, limited infrastructure, and lack of localized content. To address these challenges, we propose a RISC-V based system-on-chip (SoC). The low-cost mobile phones will be tailored for the population of Lesotho, leveraging the following AI applications.

Application	Short Description	Key Computational Tasks	Notes (Relevance)
Voice Authentication	Unlock phone with a user's voice	Pattern matching, ML inference	High relevance to mobile banking and user privacy
Voice-Driven Financial Transactions	Send money or make payments via spoken commands	Speech parsing, keyword extraction, transaction logic	Enables financial inclusion for low-literacy users
Biometric Authentication	Authenticate users using facial data	Euclidean distance calculation, feature matching	Secure access to personal and financial data
Signal Strength Estimation	Predict network quality based on recent signal values.	Moving average computation, noise filtering	Helps users optimize phone usage in low-signal areas
Transaction Geo-tracking	Keep track of geographic locations where transactions take place.	GPS/GNSS Signal, Location tagging, Processing, Geofencing	Supports fraud detection and rural financial mapping.

This project identifies four AI enabled applications that address real challenges in communication. Each application is chosen for its practical impact and is supported by a lightweight AI workload and clear optimization strategies to ensure efficient operation on mobile devices operating on limited resources.

AI workload:

The representative applications in this project share several lightweight but critical workload characteristics. Most tasks involve modest arithmetic intensity, relying heavily on basic

mathematical operations such as distance calculations, averages, and comparisons. There is minimal use of complex floating-point arithmetic or matrix operations.

Voice and biometric recognition primarily rely on pattern matching and simple machine learning inference, which are compute-light but must execute with low latency. These applications require moderate memory bandwidth for storing and comparing keyword strings, facial data, and transaction logs, but do not involve large datasets. Data movement is mostly local, involving loading small arrays, accessing feature vectors, and updating balances.

Transaction geo-tracking introduces intermittent use of location data, with minimal processing per transaction but a need for periodic updates and storage. Across all applications, the workloads are control-flow dependent and involve decision-making based on conditional logic (e.g., command parsing or authentication success/failure). Importantly, all tasks must operate efficiently under limited power, storage, and processing resources typical of low-cost mobile environments, making energy-efficient, compact designs essential.

Initial Insights for Processor Design

- Efficient handling of short strings and conditional comparisons
- Low-latency execution of lightweight arithmetic operations
- Minimal memory footprint with fast access to small data structures
- Energy-efficient execution for always-on voice and biometric monitoring
- Support for periodic GPS data retrieval and simple analytics
- Optimized for control-heavy, non-parallel workloads with minimal floating-point usej

References

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