Agentic ECG HRV Baseline Evaluation System

Agentic AI Course - Final Presentation

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Outline

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The Personalization Gap in Healthcare

- **Fixed Thresholds**: Universal clinical standards fail to account for individual baseline variations.
- **Activity State Bias**: Physiological signals shift significantly between **Rest** and **Active** states.
- **Manual Review Burden**: Technical staff must manually verify massive amounts of discarded ECG data.

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Our Motivation: Agentic Solution

- **Adaptive Context**: Utilizing Agents to handle multiple activity contexts (Rest / Active).
- **Scalability**: Reducing manual verification through autonomous quality validation loops.

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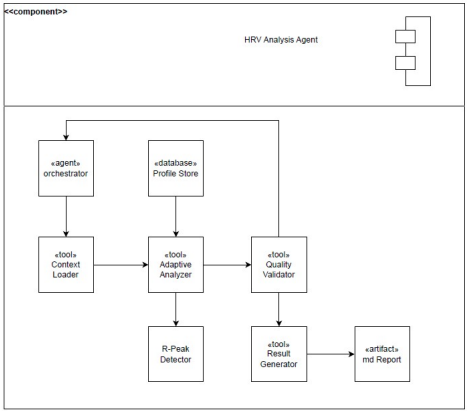
HRV Analysis Agent Workflow

- **Orchestrator**: Coordinates data ingestion and schedules analysis tasks.
- **Adaptive Analyzer**: Selects optimal filtering and R-Peak Detector based on real-time signal quality.
- **Quality Validator**: Verifies HRV metrics against personalized distributions.



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Personalized Profile Store

Personalized Baselines (`baselines.json`)

Maintains individualized physiological baselines to enable context-aware validation across different activity states.

- Stores statistically estimated reference ranges for HRV metrics such as RMSSD, SDNN, and mean heart rate.
- Enables the agent to capture a user's unique heart rate signature over time.

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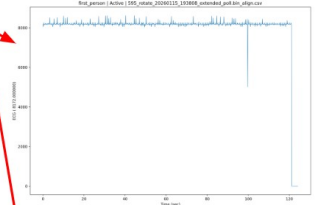
Demo & Results

person	Activity	n_windows	n_pass	Pass Rate
first_person	Rotate	5	0	0.00
first_person	Bike (Level 5)	19	17	0.895
first_person	Bike (Level 3)	17	16	0.941
first_person	Bike (Level 1)	21	21	1.00
first_person	Speak	5	5	1.00
first_person	Static (Level 1)	5	5	1.00
first_person	Static (Level 3)	7	7	1.00
first_person	Static (Level 5)	5	5	1.00
second_person	Bike (Level 1)	19	18	0.947
second_person	Bike (Level 5)	17	17	1.00
second_person	Bike (Level 3)	19	19	1.00
second_person	Rotate	7	7	1.00
second_person	Speak	5	5	1.00
second_person	Static (Level 1)	5	3	0.60
second_person	Static (Level 3)	5	5	1.00
second_person	Static (Level 5)	5	5	1.00



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Challenges & Lessons Learned

- **Challenge**: Managing the trade-off between Agent reasoning depth and real-time processing speed.
- **Lesson**: Importance of standardized data preprocessing for ECG signals (HRV analysis from ECG).
- **Observation**: Agentic AI significantly reduces ”Activity State Bias” compared to static systems.

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Summary

- **Innovation**: Our system capture individual norms to bridge the monitoring gap.
- **Efficiency**: Adaptive loops reduce the need for manual signal quality verification.

Thank you! Questions?

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Team Contribution

- **Chu, Yen-Chieh**:
  Data-group, Chatbase, Slide, Presentation
- **Lin, Chih-Yi**:
  Project-code-group, Tests-group, Agentic approach, Slide, Presentation
- **Lin, Wen-Hsin**:
  System-design-group, Chatbase, Presentation

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