

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.



Our Motivation: Agentic Solution

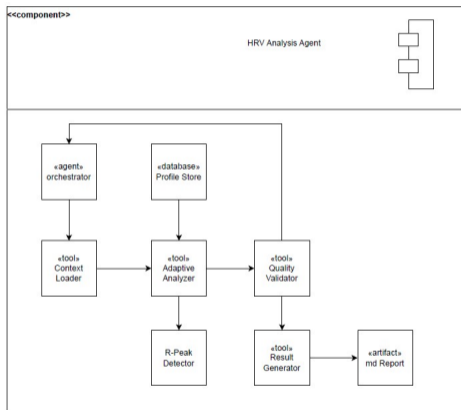
- **Adaptive Context:** Utilizing Agents to handle multiple activity contexts (Rest / Active).
- **Scalability:** Reducing manual verification through autonomous quality validation loops.





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.



Personalized Baselines (`baselines.json`)

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

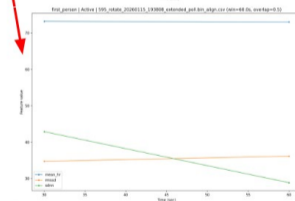
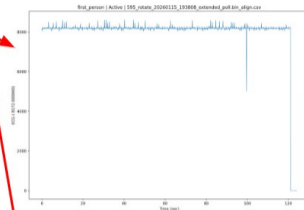
- Stores statistically estimated reference ranges for HRV metrics such as RMSSD, SDNN, and mean heart rate.
- Enables the agent to "learn" a user's unique heart rate signature over time.





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



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.



Summary

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

Thank you! Questions?





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

