# RESEARCH LOG ENTRIES

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| **Date** | **Objective** | **Methods** | **Results** | **Next Steps** | **Mentor Signature** |
| 2024-11-06 | Define system requirements and draft initial architecture | Conducted literature review, sketched multi-layer architecture, and held kickoff meeting. | Finalized sensor list and block diagram approved. | Develop feature extraction plan and evaluate hardware kits. |  |
| 2024-11-20 | Implement and test PPG preprocessing pipeline | Developed firmware for 50 Hz PPG sampling and applied band-pass filter on-device. | Achieved significant artifact reduction and measured CPU overhead. | Add HRV feature extraction and FFT module. |  |
| 2024-12-05 | Extract and validate HRV features | Computed RR intervals and HRV metrics in Python, compared against ECG ground truth. | Achieved low error in RR estimation and high correlation in HRV metrics. | Integrate EDA pipeline and collect calibration data. |  |
| 2025-01-15 | Integrate EDA sensor and gather baseline data | Connected EDA module, implemented filtering and RMS calculation, and ran stress tests. | Observed clear RMS differences between rest and stress with low false positives. | Merge PPG and EDA features for model training. |  |
| 2025-02-01 | Train initial RF and SVM models | Labeled windows of biometric data and trained RF and SVM with cross-validation. | Random Forest selected with 91% accuracy and acceptable TPR/FPR. | Implement unsupervised detection methods. |  |
| 2025-02-28 | Develop unsupervised anomaly detectors | Trained Isolation Forest and autoencoder on normal data to set thresholds. | IF and AE achieved TPRs of 85% and 88% respectively with low FPR. | Combine models in ensemble voting. |  |
| 2025-03-20 | Prototype ensemble on-device and measure metrics | Deployed models on WearOS, measured latency and battery impact. | Average detection latency 3.7s and 15% daily battery drain. | Optimize model size and begin lab validation. |  |
| 2025-04-10 | Lab tests for alert performance | Simulated distress sessions, recorded alert dispatch times and false alarms. | Mean dispatch time 35.4s, TPR 94%, FPR 7%. | Prepare IRB protocol for field trial. |  |
| 2025-04-25 | Plan field trial and submit IRB | Drafted consent forms, submitted proposal, and scheduled participant deployment. | IRB approved and participants recruited. | Distribute devices and conduct training. |  |
| 2025-05-01 | Launch field trial | Deployed devices, oriented participants, and set up monitoring server. | Successful deployment with initial alerts logged. | Continue trial and collect mid-term feedback. |  |