

P-Fall: Personalization Pipeline for Fall Detection on Wearables

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Motivation

- Fall is one of the leading causes of death and injury among the elderly.
- One in four Americans aged 65 and older falls each year.
- Over 800,000 patients a year are hospitalized because of a fall injury.
- The cost of treating injuries caused by falls is projected to increase to over \$101 billion by 2030.

Background

- Wearable smartwatches paired with smartphones have lately brought health monitoring applications, such as fall detection, closer to reality.
- A one size fits all algorithm or even more advanced deep learning models [2] have proven to be ineffective at covering all patterns of falls and differentiate it from the Activities of Daily Living (ADL) data.
- Our previous work [1], using simulated data, demonstrated that we can detect most falls and ADLs using a deep learning and a personalization strategy.
- This strategy involved a deep learning model trained offline on simulated falls and labeled ADL data collected in real-time from users (feedback data) while wearing the smartwatch for a specified period.

P-FALL Pipeline Architecture

- The Config module manages the hyper parameters, version of the deep learning model.
- The Database module manages all the data sensed on the watch and phone, uploading of the data to the cloud, and downloading of the best re-trained model for a user.
- The Data Collector module manages the communication between the smartwatch to the smartphone using BLE and the rate of data transfer.
- The Prediction module manages different machine learning models used for fall detection.

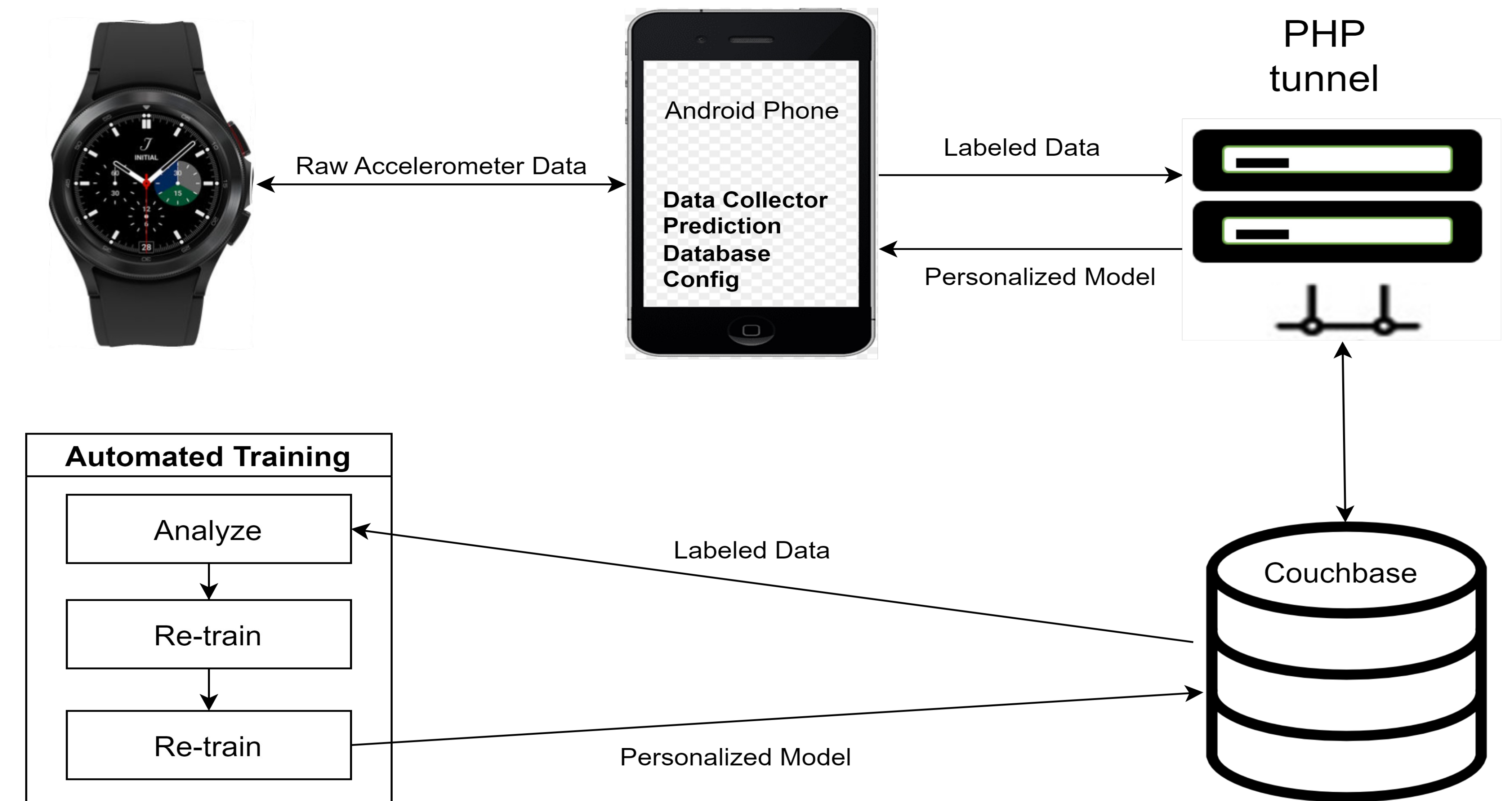


Fig 1: Overview of the System

Smart-Fall Applications

- We followed the best practices for the design of the UI for older adults.
- The applications are designed for the ease for users to provide feedback on a detected fall.

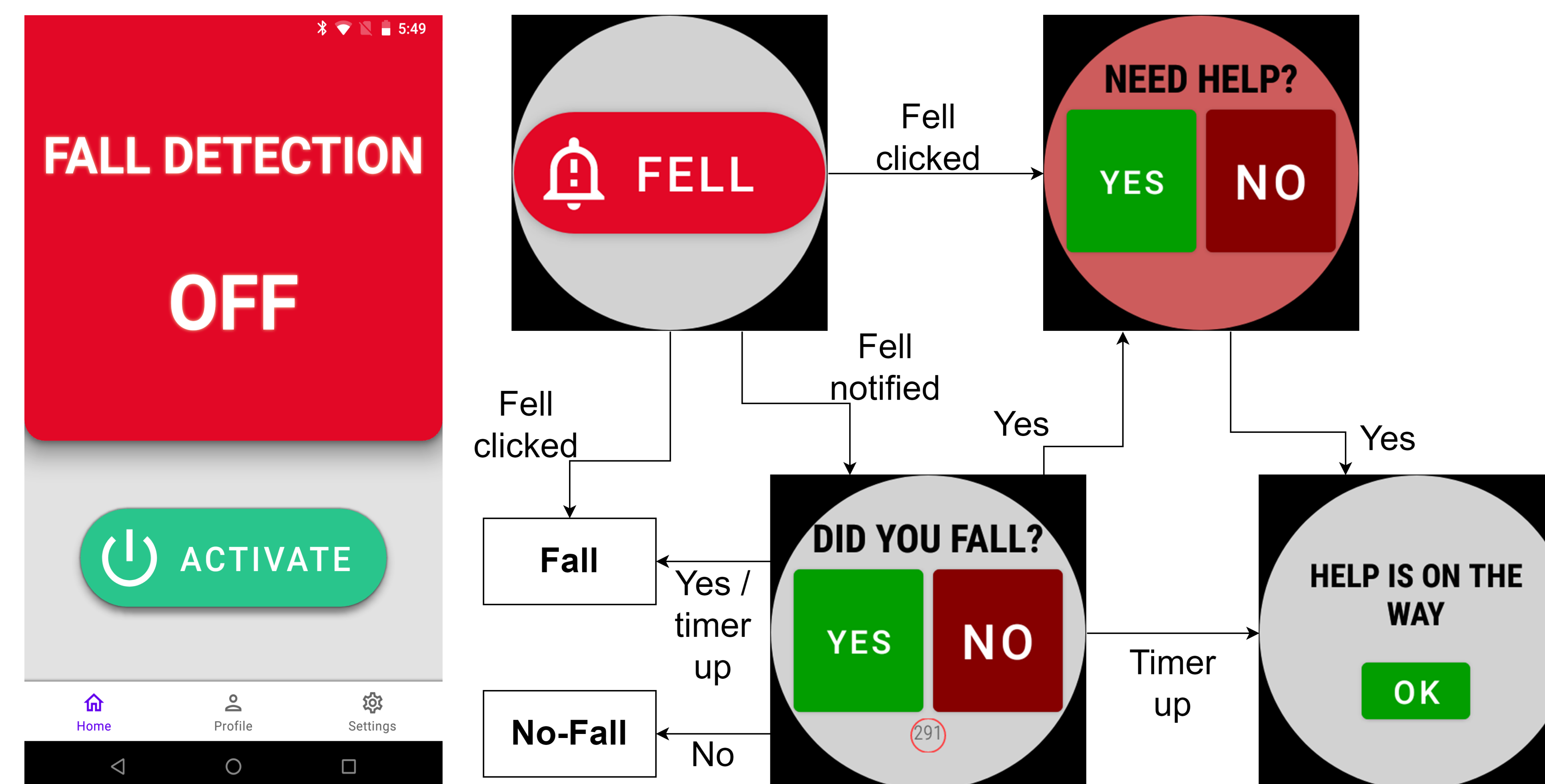


Fig 2: Phone and Watch's User Interface

Results and Conclusions

- This system was trialed with 3 users over 5 days period and the number of false positives in one user reduced from the average of 109 to 18 after personalization.
- P-Fall architecture is a robust platform for collecting IoT sensor data and processing sensor data on the edge device that preserves privacy.

References

1. Ngu, AHH et al, "Personalized Watch-based Fall Detection Using a Collaborative Edge-Cloud Framework", International Journal of Neural Systems, 2022.
2. T Theodoridis et al. "Human Fall Detection from Acceleration Measurements using a Recurrent Neural Network". ICBHI 2017.