

Goals

- ❑ Develop a wearable device capable of recording and processing motion data in order to automatically detect a fall.
- ❑ Develop a Android application for user accessibility and to receive alerts.
- ❑ Develop a server to maintain a database of users and paired wearables. Server will also send alerts in case of a fall.

Motivations and Objectives

- ❑ Motivations
 - Falls are the number one cause of injuries and injury related death in older Americans.
 - Falls make it a danger to stay at home alone without a caretaker for the elderly.
 - Majority of fall detection systems are either manual or locked behind a monthly subscription fee.
- ❑ Objectives
 - Create an automatic fall detection system which is not reliant on people and is able to operate in the worst-case scenarios such as unconsciousness due to fall.
 - Make the system more cost-effective for the user compared to competitors.

Challenges

- ❑ Fall Detection Algorithm
 - Differentiate accelerometer data peaks between high impact scenarios such as running/falling.
 - Sudden stops & bumping into walls triggering algorithm as a fall.
 - Fall detecting with offset gravity. (Stairs, elevator.)
- ❑ Communication past WIFI range between phone/wearable.
- ❑ Sending alerts to the guardian's phone.

Acknowledgement

We would like to thank Professor Spasojevic for his insight and ideas regarding the project.

Methodology

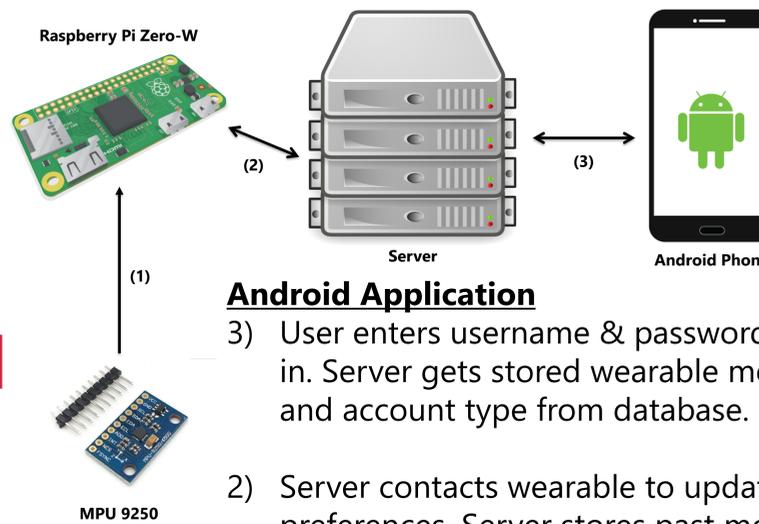


Figure 1: System Interaction Diagram

Fall Detection

Android Application

- 3) User enters username & password to log in. Server gets stored wearable model # and account type from database.
 - 2) Server contacts wearable to update user preferences. Server stores past motion data so user can observe retroactively.
- 1) MPU 9250 Accelerometer collects motion data and sends it to Raspberry Pi Zero-W to process. Raspberry Pi Zero-W applies algorithm to continuous stream of data.
 - 2) If fall is detected Zero-W contacts server using WIFI and reports a fall for specific prototype model. Server finds associated guardian information.
 - 3) Server sends out alert to guardian's Android Phone through application alerting the guardian that the person has fallen.

Results

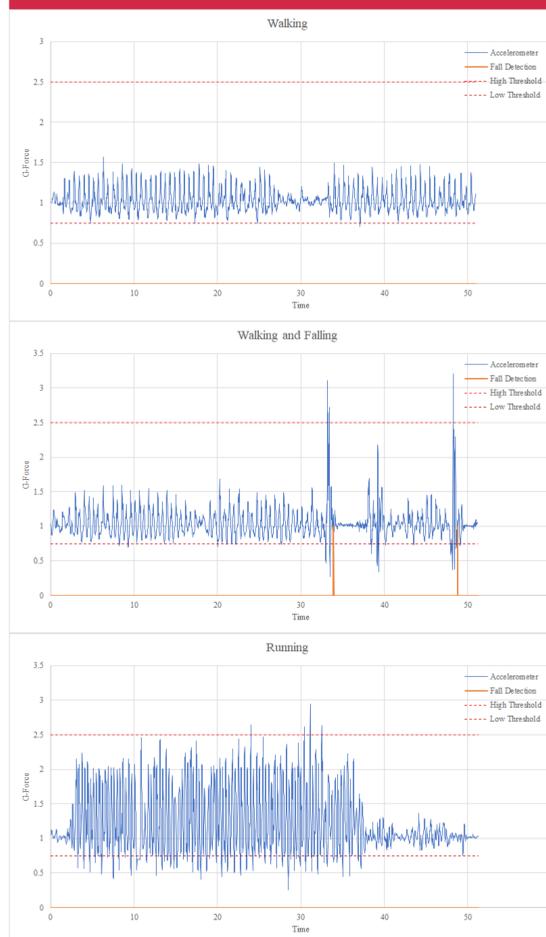


Figure 2: Walking, Running, & Falling motion data.

Android Application

- ❑ Communication between systems done with WIFI.
- ❑ Fully functioning app. & server allow for long distance fall detection.
- ❑ Wearable must be connected to WIFI to be operational.

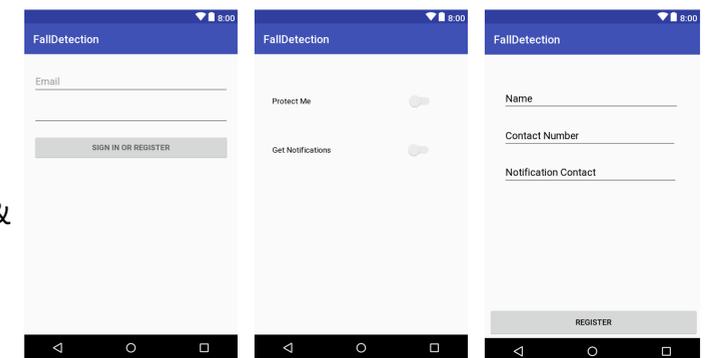


Figure 3: Application UI

Fall Detection

- ❑ Python algorithm generates an average of the 3-axes motion data and observes first if low threshold has been breached, if true then waits for high threshold to be breached.
- ❑ If movement stops, indicating a large impact then minimal movement usually inferred as a fall. If movement continues with constant high impacts then movement is not inferred as a fall. See: Running Motion Data.
- ❑ Thresholds can be modified for more active users however they are currently set with less active, elderly people in mind.

References

[1] <https://www.cdc.gov/HomeandRecreationalSafety/Falls/adultfalls.html>