

# CYBR 8080 - eGuard

PROJECT MILESTONE 2

# Project Goals

- ▶ Android application, which uses Metawear device for fall detection and emergency alerts
- ▶ Use Metawear device's 3-axis accelerometer to detect and monitor user activity
- ▶ Determine and differentiate various user movement patterns
- ▶ Continuously monitor transition of user movements from type to another
- ▶ Calculate a threshold value for scenarios involving a fall
- ▶ Calculate the change in acceleration for each transition and compare with a threshold value
- ▶ Raise an alert in case a fall is detected

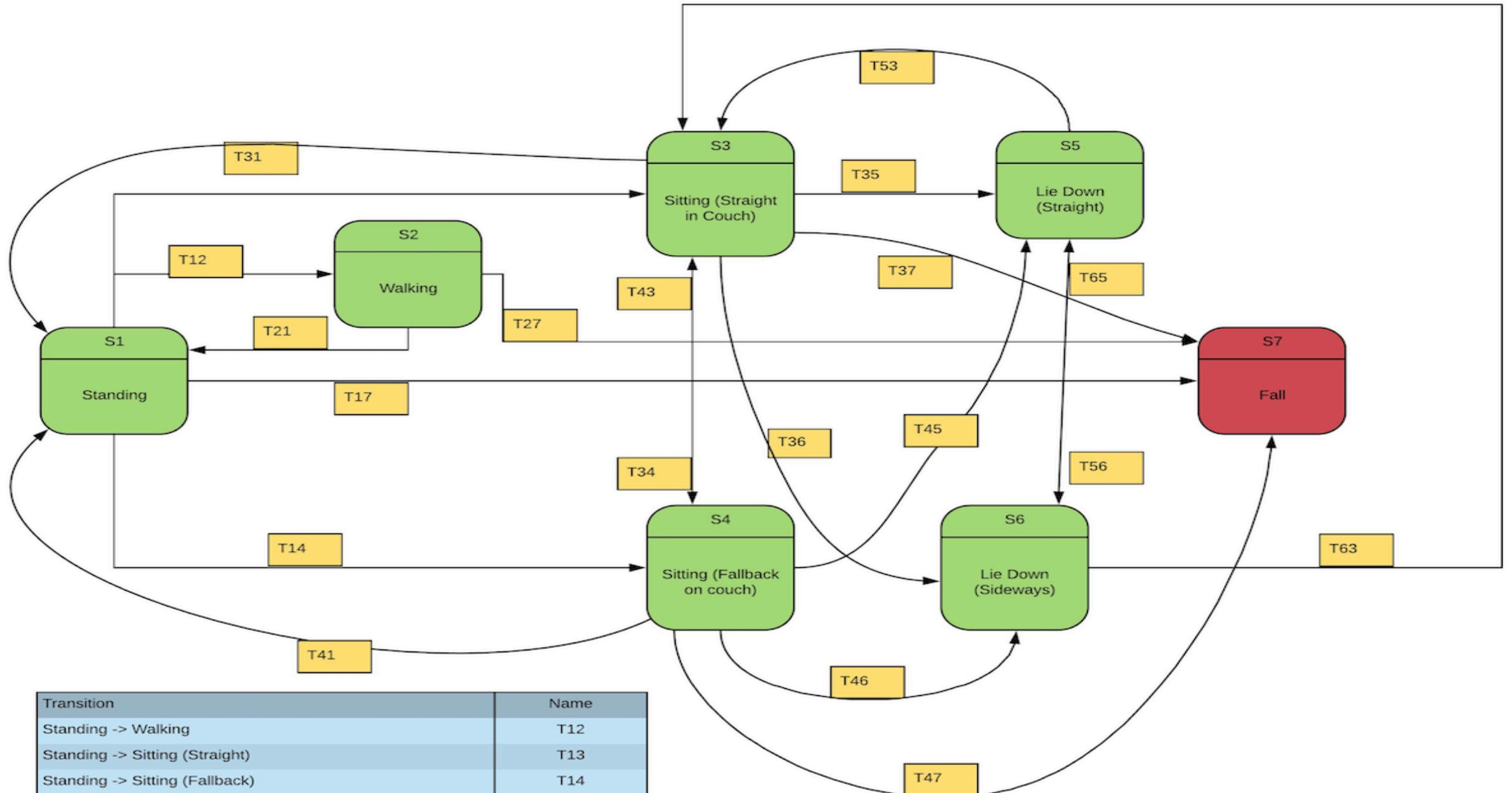
# User Stories - Recap

- ▶ **User Story 1**
  - ▶ As a user, I want to detect the different user movements of a user during the course of a day, such as Sitting (Straight & Fallback), Standing, Sleeping (Straight & Sideways)
- ▶ **Acceptance Criteria**
  - ▶ When a person is walking, standing or sleeping, the application should monitor these normal movements continuously
- ▶ **User Story 2**
  - ▶ As a user, I want to be able detect transitions in movement patterns of a user such as from Sitting to Standing; Standing to Walking; Sitting to Sleeping; etc.
- ▶ **Acceptance Criteria**
  - ▶ When a person makes a transition from type of movement to another, the application should monitor and check for the change in acceleration of the user continuously, and differentiate between normal transitions and fall transitions
- ▶ **User Story 3**
  - ▶ As a user, I want to know if the user's transition indicates a fall and the application should make an emergency alert.
- ▶ **Acceptance Criteria**
  - ▶ Application should monitor the user acceleration and correctly indicate, if the user has fallen, based on sudden increase in acceleration by checking a threshold value

# Architecture Design

- ▶ Application opens and connects to Metawear device via BLE
- ▶ Continuously track user acceleration and changes in user acceleration
- ▶ Compare acceleration with threshold value and monitor transitions in user movements
- ▶ In case the threshold value is reached or exceeded, identify the user has suffered a fall, and raise an alert
- ▶ Send an alert message

# State Diagram



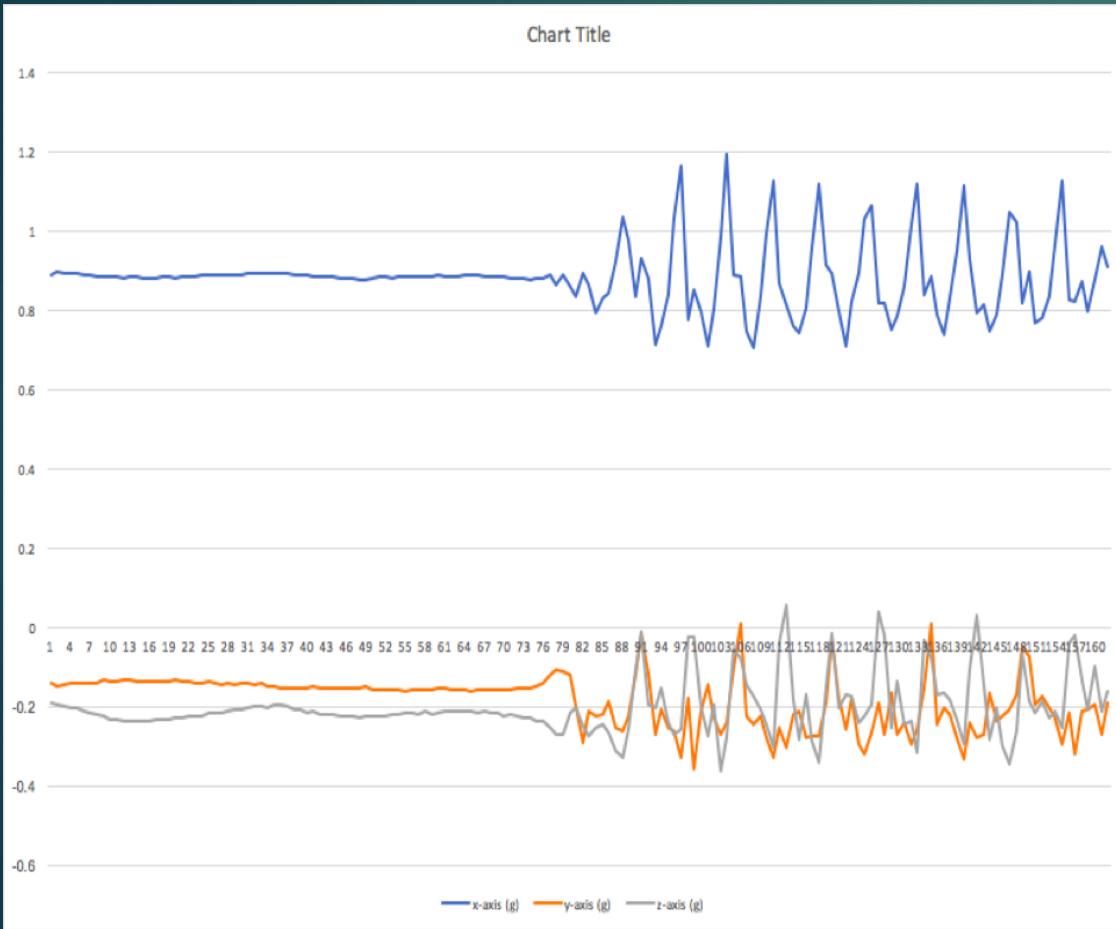
# Transitions in User Movement

Transition	Transition Type	Threshold Value (Change in Acceleration Magnitude during Transition)
T12	Standing to Walking	0.9 to 1.24
T13	Standing to Sitting(Straight)	0.92 to 1.17
T14	Standing to Sitting(Fallback)	0.92 to 1.18
T17	Standing to Fall(Front)	0.95 to 3.8
T17	Standing to Fall(Back)	0.95 to 2.2
T21	Walking to Standing	1.2 to 0.93
T27	Walking to Fall	1.1 to 4.5
T31	Sitting(Straight) to Standing	0.91 to 1.3
T34	Sitting(Straight) to Sitting(Fallback)	0.92 to 0.84
T35	Sitting(Straight) to Lie Down(Straight)	0.91 to 0.96
T36	Sitting(Straight) to Lie Down(Sideways)	0.92 to 2.2
T37	Sitting(Straight) to Fall	0
T43	Sitting(Fallback) to Sitting(Straight)	0.97 to 0.99
T45	Sitting(Fallback) to Lie Down(Straight)	0
T46	Sitting(Fallback) to Lie Down(Sideways)	0
T47	Sitting(Fallback) to Fall	0
T53	Lie Down(Straight) to Sitting(Straight)	0.99 to 1.09

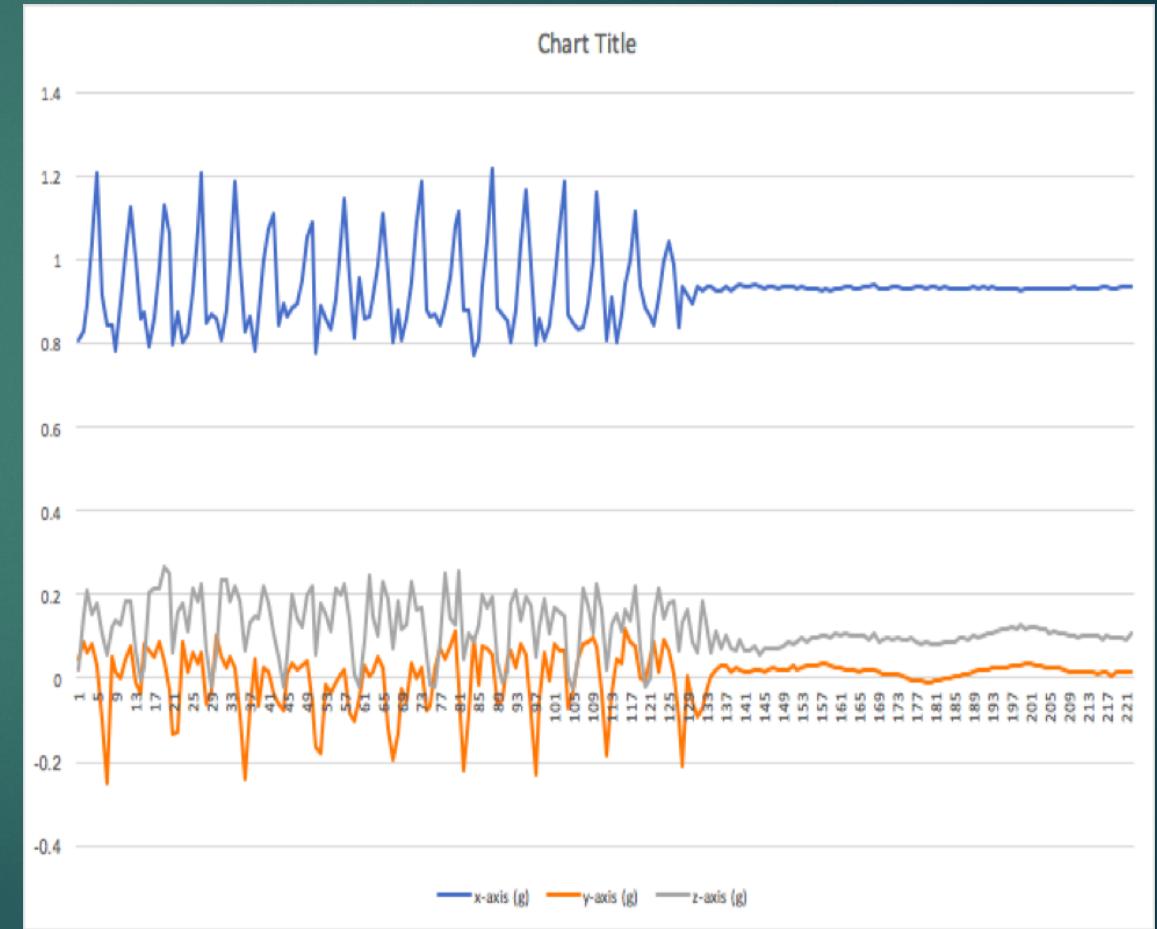
T56	Lie Down(Straight) to Lie Down(Sideways)	0.98 to 1.89
T63	Lie Down(Sideways) to Sitting(Straight)	0.97 to 1.1
T65	Lie Down(Sideways) to Lie Down(Straight)	1 to 1.09

# Graphs to indicate Transitions

T12 – Standing to Walking

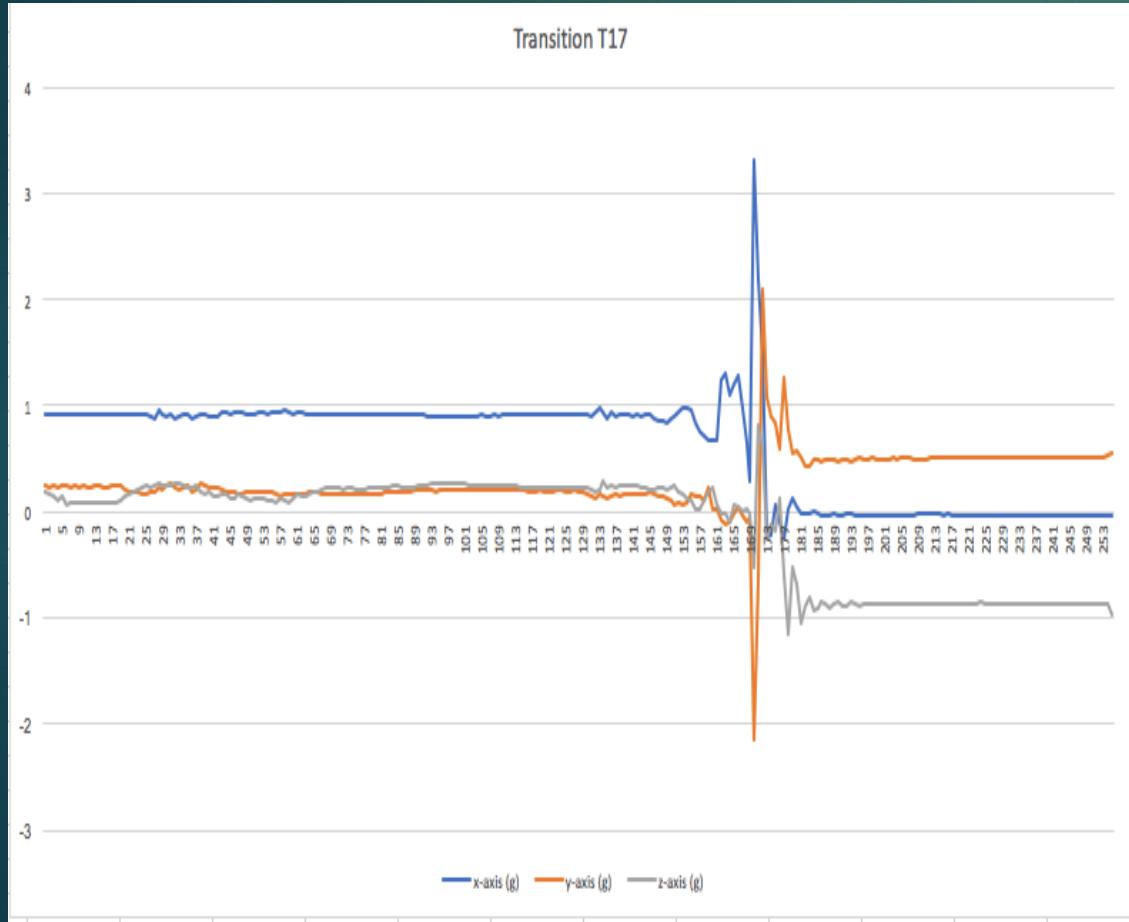


T21 – Walking to Standing

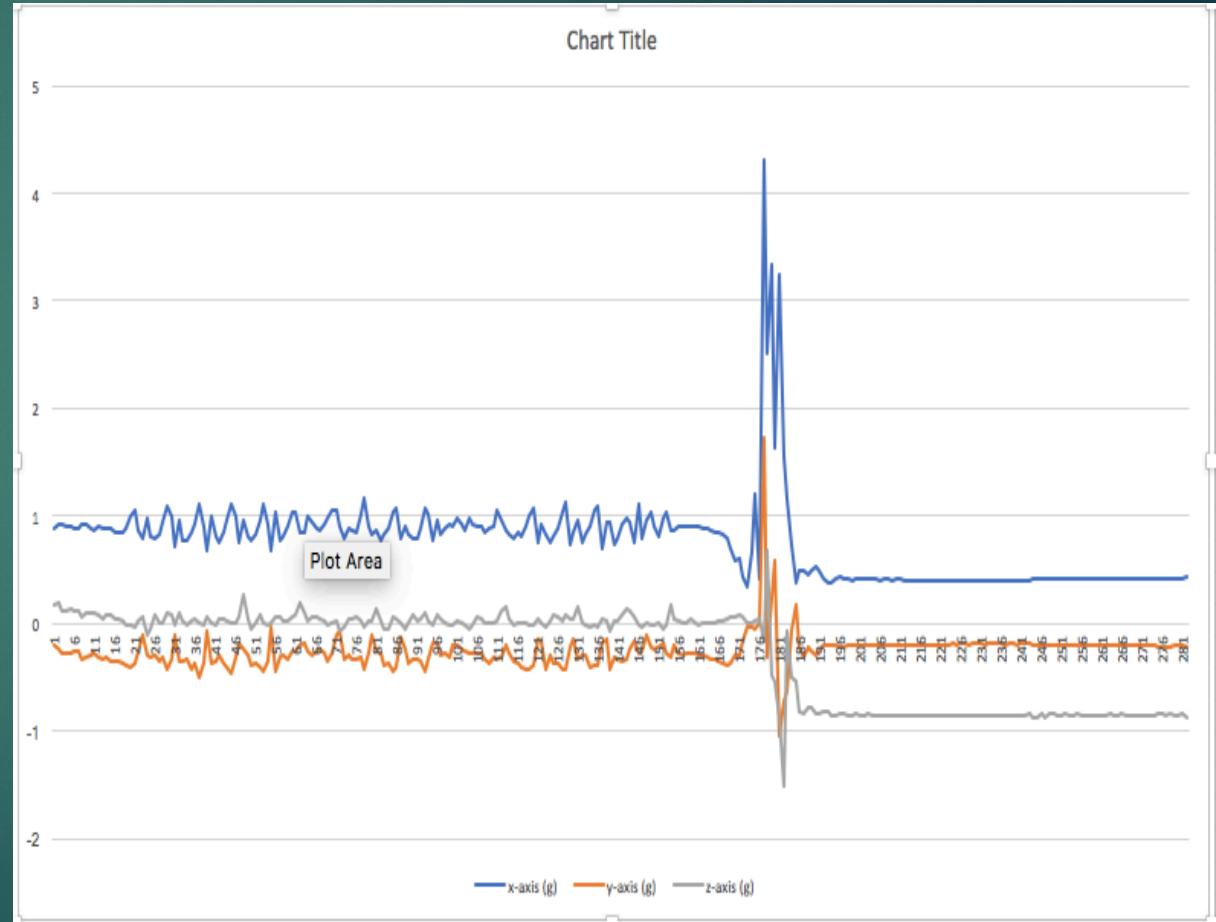


# Graphs to indicate Transitions

T17 – Standing to Falling



T27 – Walking to Falling



All graphs in Link below:

<https://github.com/Narahari-Sundaragopalan/eGuard/tree/master/data-source>

# Threshold Value Calculation

- ▶ Magnitude of Acceleration =
  - ▶ Square Root of the Sum of the Squares of the values in each of the axes of the accelerometer.
  - ▶ Acceleration = { Square Root of (  $X^2 + Y^2 + Z^2$  ) }
  - ▶ X – Reading in X-Axis of Accelerometer
  - ▶ Y – Reading in Y-Axis of Accelerometer
  - ▶ Z – Reading in Z-Axis of Accelerometer
- ▶ Threshold Values for all cases are specified in the Table

# As part of Milestone 2

- ▶ As specified in User Story 1, I tracked different user movements and corresponding patterns, such as Sitting (Straight & Fallback), Lie Down(Straight & Sideways), Falling, Standing, Walking.
- ▶ As specified in User Story 2, I detected the transitions from one type of movement to another, and calculated the change in acceleration.
- ▶ As specified in User Story 3, I calculated a threshold value, for a fall scenario, for the application to compare and raise an alert in such a case.

# Issues Faced

- ▶ Losing connection with Metawear device intermittently, while testing
- ▶ Unable to connect to the Metawear device on a consistent basis