MAPFOLIO

Mapping indoor spaces with mobile devices

Problem

The property rental process has moved online, but the process of creating a floor plan does not take advantage of current technology.

Solution

Mapfolio makes floor plan creation possible on a smart phone.

A user measures a room by touching the phone to each wall.

Hardware

A smartphone measures how it is being manipulated in three dimensional space using two pieces of hardware:

Accelerometer - detects how rapidly the smartphone's velocity is changing.

Gyroscope - detects the smartphone's current orientation.

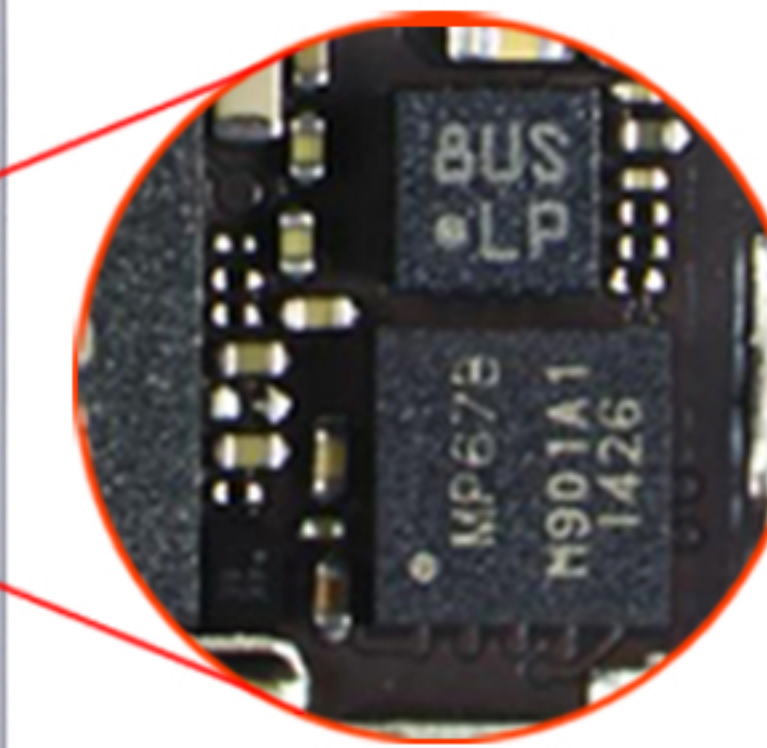A javascript API, "Full-Tilt," captures raw data from the hardware in a mobile browser.

iPhone 6's Bosch BMA280 accelerometer (above), and invenSense MPU-6700 gyroscope (below).
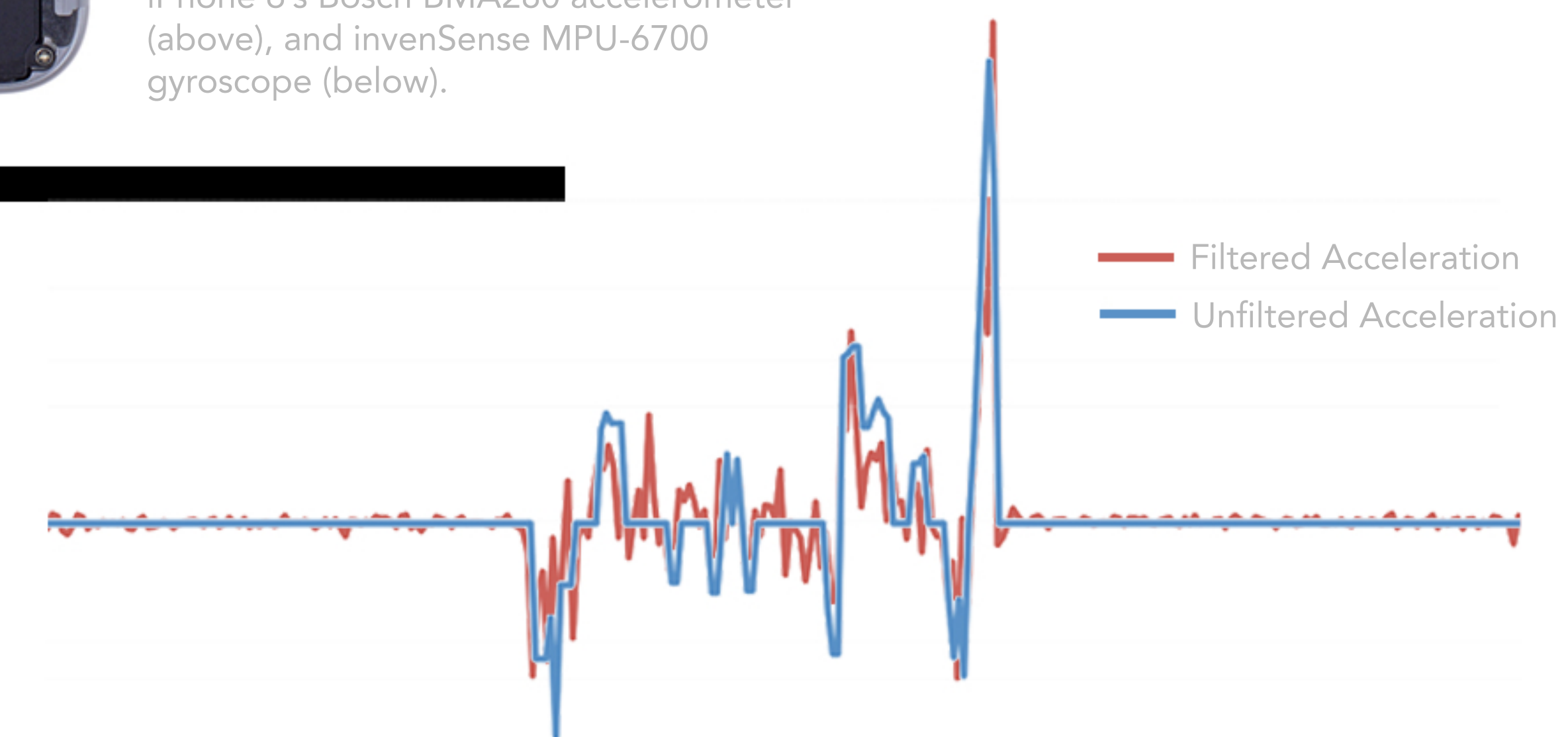
Hardware Noise

To reduce noise introduced by the hardware, we implement two filters:

Median filter - reduces noise, by removing sudden spikes in acceleration.

Low-pass filter - reduces noise by dampening the amplitude of acceleration values with frequencies higher than the threshold frequency.
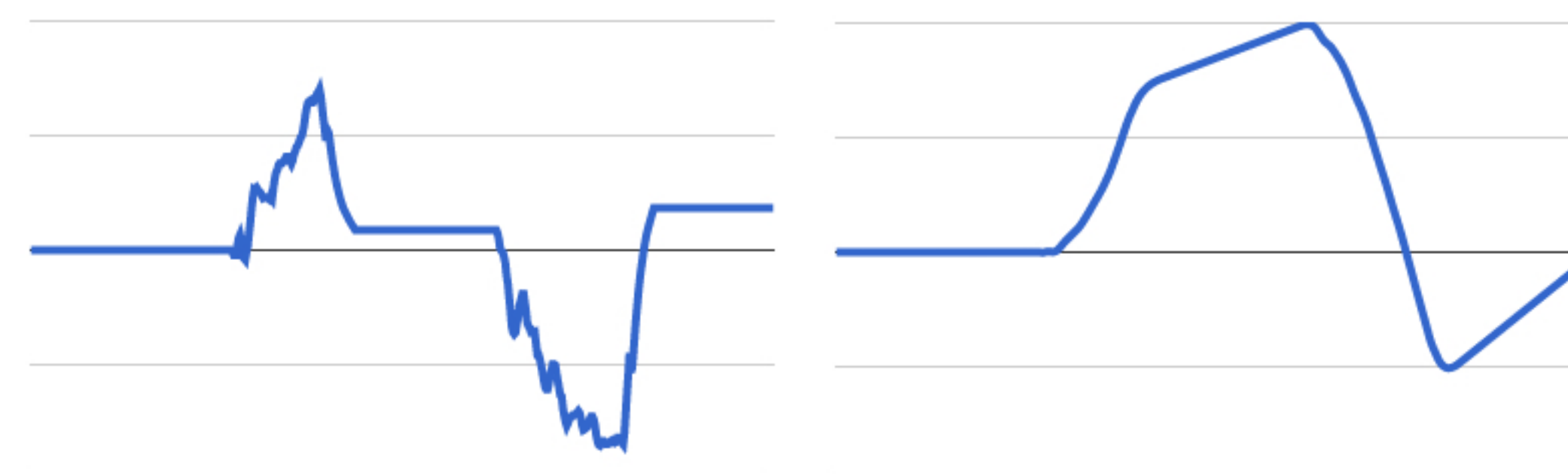
Filtered acceleration compared with unfiltered acceleration.
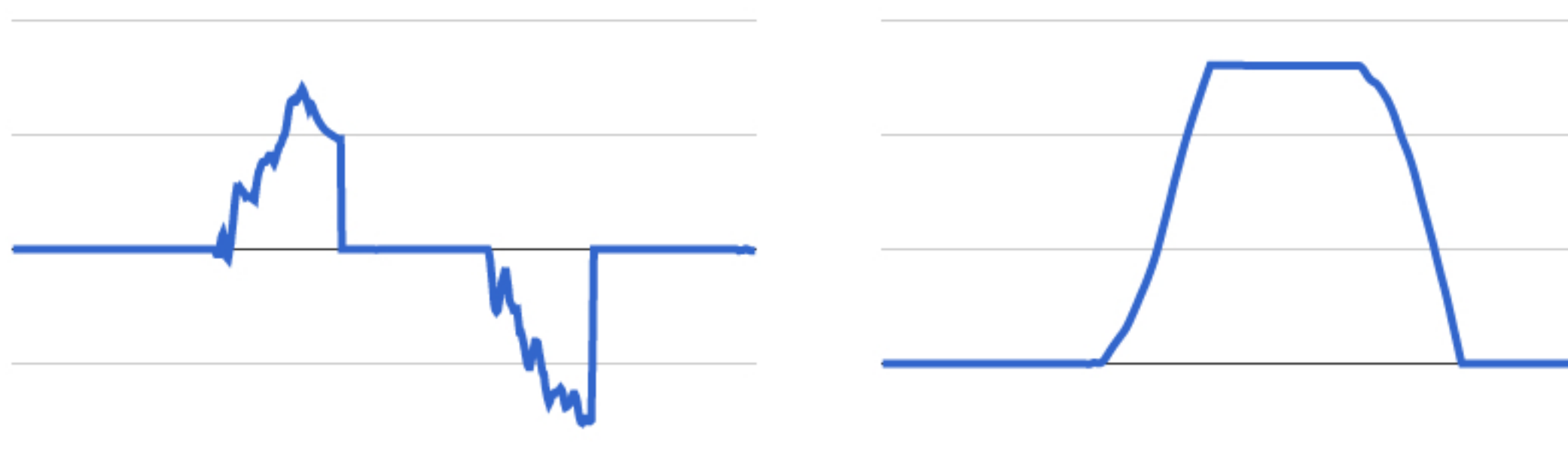
Estimation Errors

Dead reckoning is vulnerable to error accumulation, which causes the calculated position to drift inaccurately.

Unadjusted Velocity v. Time

Position v. Time

To reduce error accumulation, the velocity is set to zero when the accelerometer indicates that the phone has stopped moving.

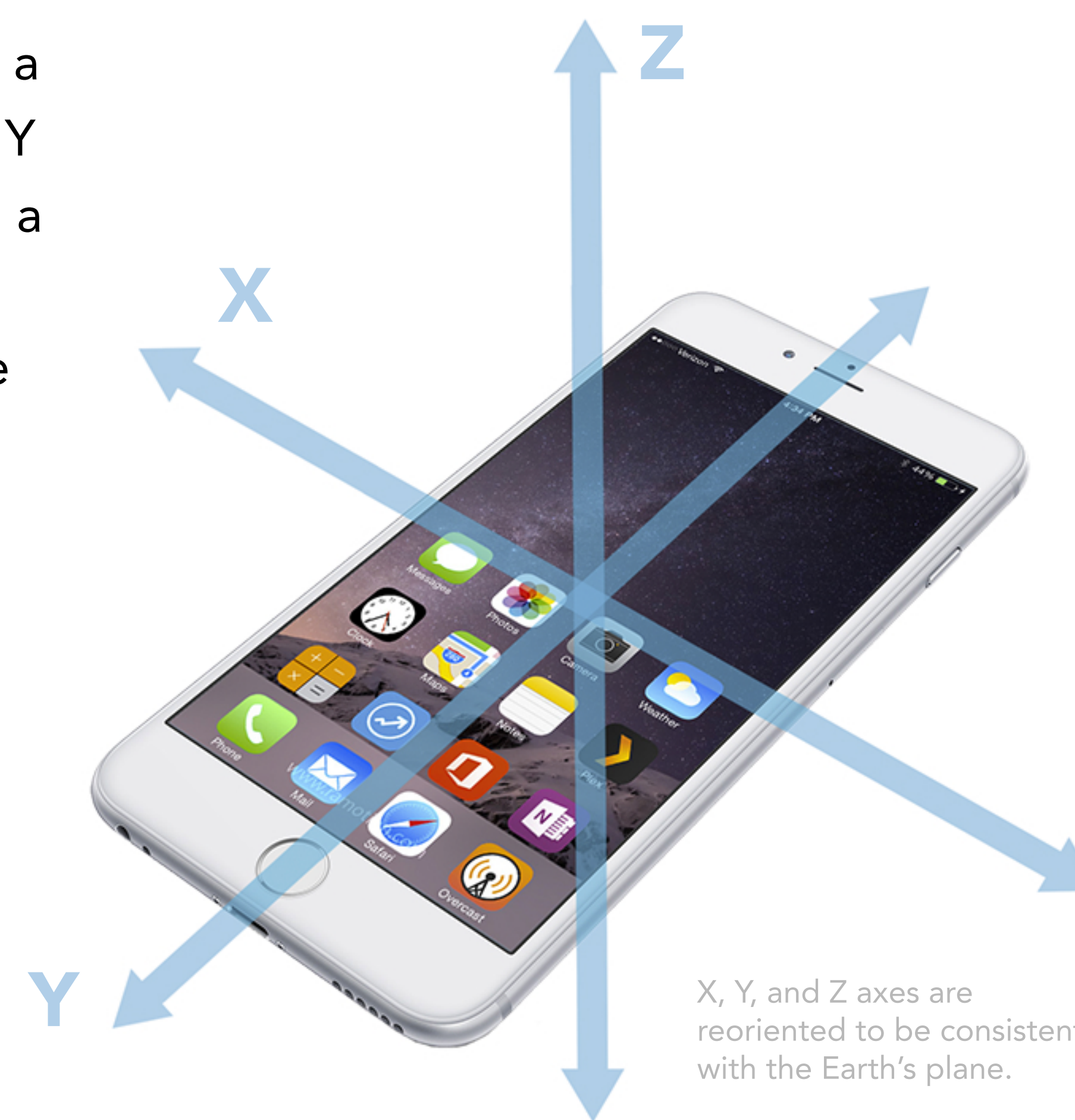Adjusted Velocity v. Time

Position v. Time

Calculating Relative Position

Relative position is calculated by advancing the previously determined position using an estimated velocity, a method called "dead reckoning."

Determining Direction

To determine the direction of the phone's motion, gyroscope values are used to perform quaternion rotations on the acceleration data.
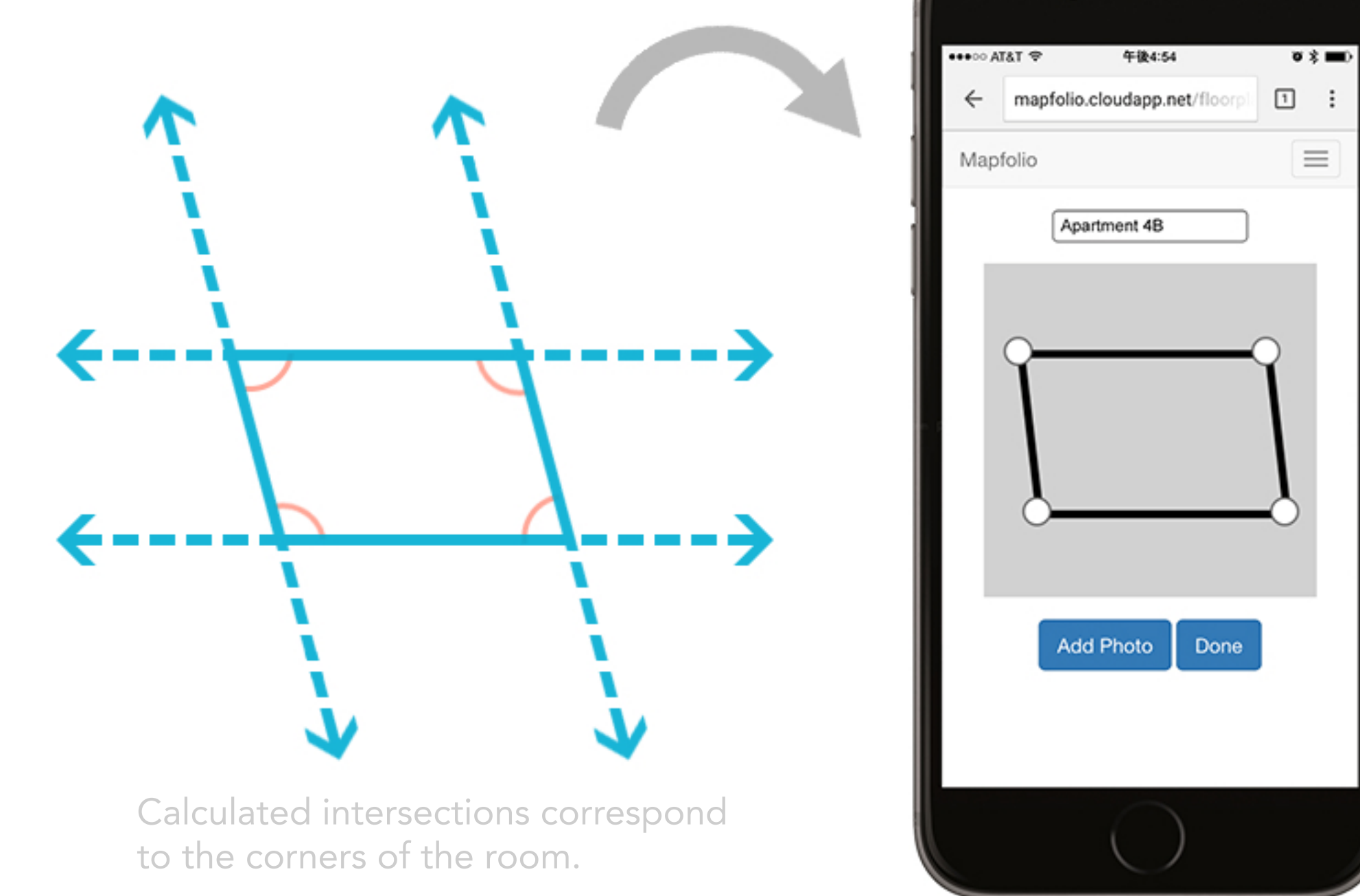
This yields a relative X, Y position in a consistent coordinate system.

X, Y, and Z axes are reoriented to be consistent with the Earth's plane.

Creating the Image

Euclidean geometry is used to calculate the intersection points of the adjacent walls in the room. The Javascript API, "Fabric.js," renders floorplans on a webpage.

Calculated intersections correspond to the corners of the room.