Accessible Positional Tracking for Mobile VR

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Motivation

We are excited by the potential for low-cost positional tracking to further democratize the VR space. We have personally seen that while Cardboard-type devices bring VR to the average person, they give no indication that it's only a low-fidelity version of what's really possible. Positional tracking at the lowest end of VR is crucial to showing mass markets how powerful and far-reaching a tool this technology will be.

We felt that this approach would a) best take advantage of the knowledge and skills we've gained in this course and b) give us the opportunity to understand the details of why accelerometers are insufficient for high-fidelity positional tracking. It's common knowledge and oft-discussed that double integration of accelerometer data isn't "good enough," but we want to understand what that means and be able to qualify that statement.

A low-cost solution is important to our team, so we particularly aimed to explore positional tracking through use of a constrained model or additional hardware such as Estimote Beacons.

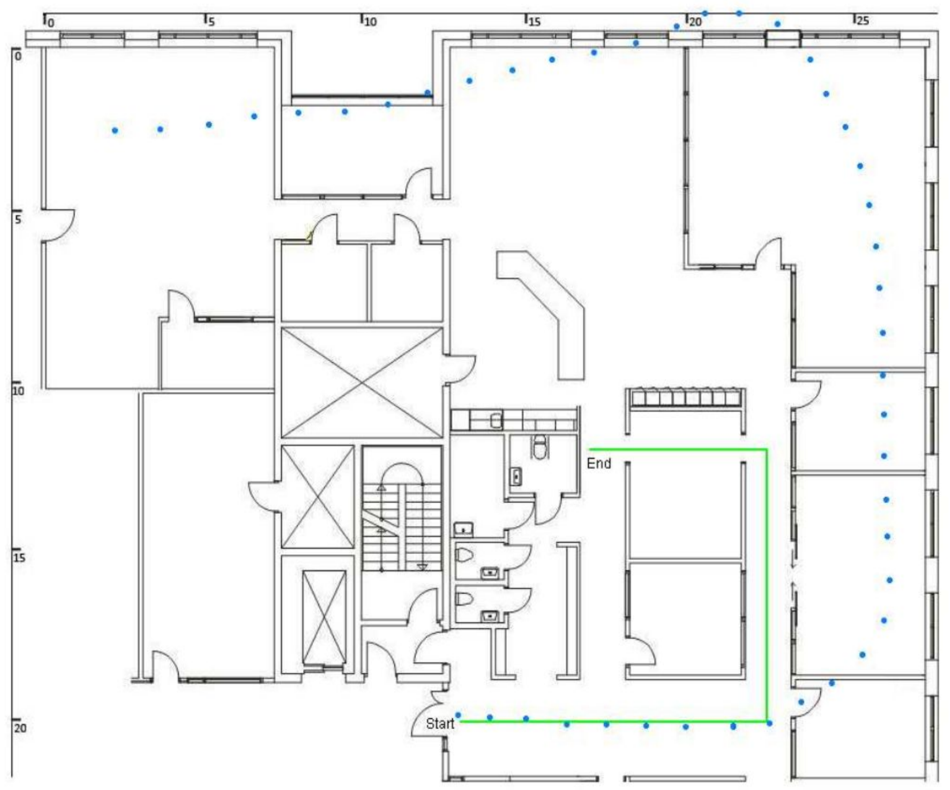
Methods

We considered multiple methods for accessible positional tracking and were most excited by the following methods: linear acceleration, step counting & kinematic constraints, and using WiFi or Estimote Beacon RSSI. The table below expands on the advantages and disadvantages of each.

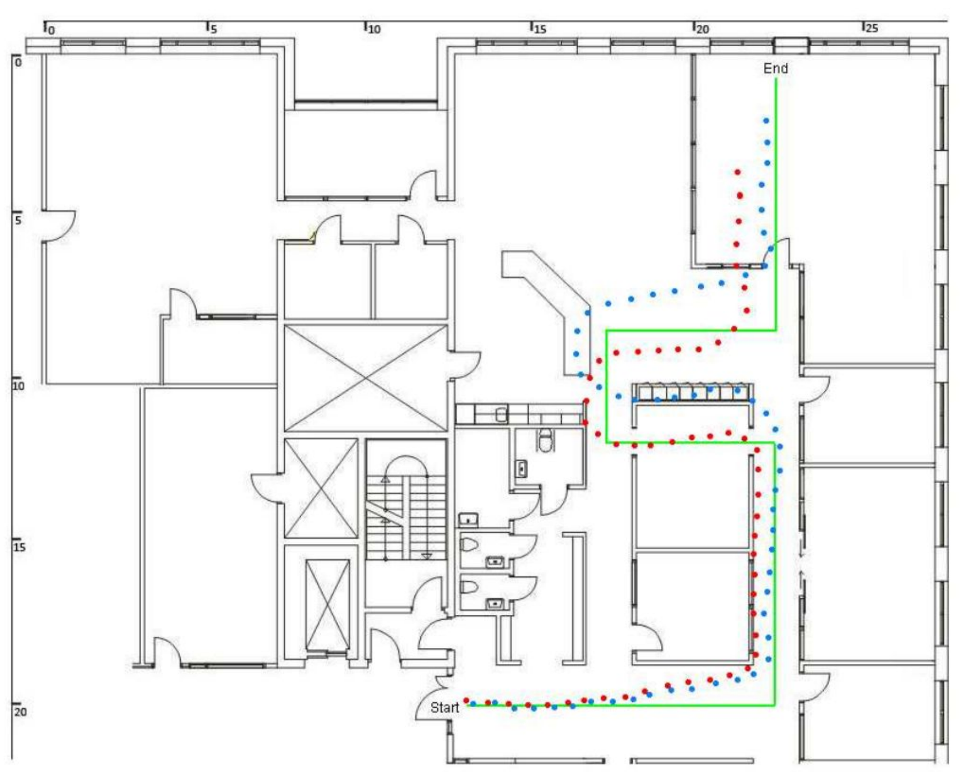
	Linear Acceleration	RSSI	Step Counting
Advantages	Acceptable accuracy at low velocity, suitable for testing	Acceptable accuracy when averaged, potentially very low-cost	Uses a generalized model, low-cost
Disadvantages	Low accuracy at high velocity, susceptible to sensor quality and noise	Susceptible to building conditions, requires extensive calibration	Existing low-cost sensors are inadequate, requires predefined parameters

Experimental Results

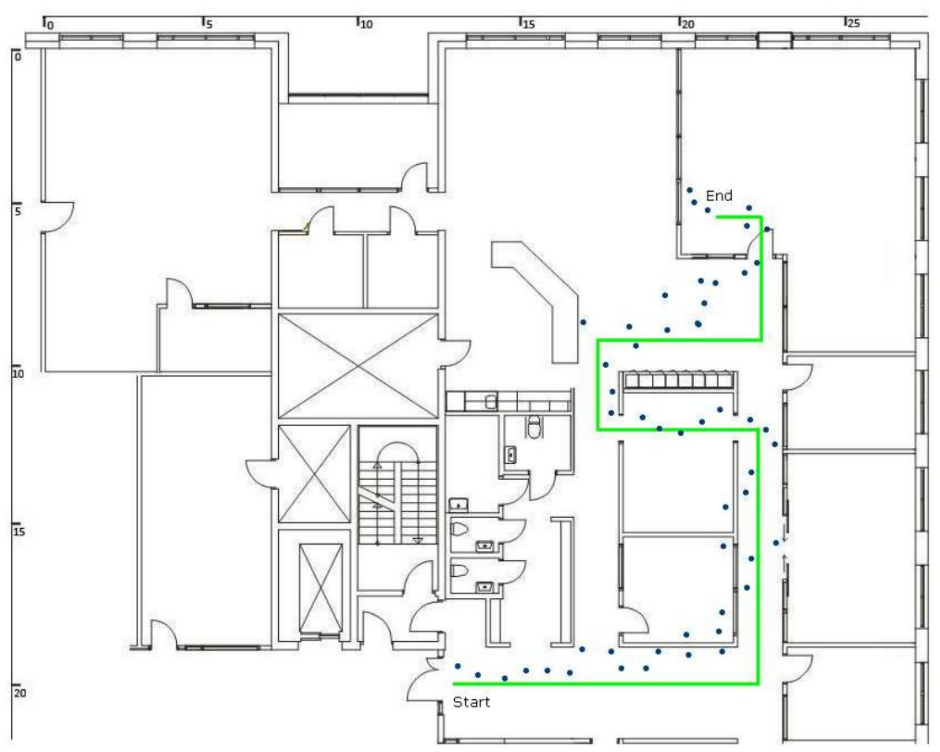
The following are results we are attempting to replicate or improve upon from Shala et. al.. For each map, the green line represents an actual path walked and dots represent tracked positions.



Tracking with Linear Acceleration



Tracking with Step Counting and Motion Model



Tracking with Average WiFi RSSI

Related Work

Indoor Positioning using Sensor-fusion in Android Devices - Shala & Rodriguez

Self-contained Position Tracking of Human Movement Using Small Inertial/Magnetic Sensor Modules - Yun, Bachmann, Moore, Calusdian

Ambulatory Position and Orientation Tracking Fusing Magnetic and Inertial Sensing - Roetenberg, Slycke, Veltink

Sensor Fusion on Android Devices: A Revolution in Motion Processing - Google Tech Talk by David Sachs

Implementing Positioning Algorithms Using Accelerometers - Kurt Seifert & Oscar Camacho