Motion Detection using Accelerometer Feedback

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Background

An accessible, open-source product enabling high-performing athletes to monitor running technique in real-time, providing feedback over a period of time. Initial work focusses on arm orientation.

Existing motion detection software is not perfect:

- Xbox Kinect™ uses Infrared technology to approximate user position and posture.
- Nintendo Wii™ uses accelerometers to track controller position in relation to sensor.

Project Outline

- Investigate and avoid weaknesses in existing Motion Detection technologies.
- Suggest a model for a superior, yet cost effective, system for tracking limb movement.
- Acceptably predict target limb angle within a few degrees (Goniometer readings will confirm values).


Accelerometers

Both Kinect™ and Wii™ depend on placement of the sensor in relation to the receiver. The product uses a reference accelerometer on the subject's chest, moving the point of reference for the sensors from the host device onto the user.

If the starting angle θ_0 is known, then the direction vector can always be calculated as y, where

$\frac{d^2y}{dx^2}$ = acceleration.

→ Direction Vector
┈┈► Accelerometer Vector
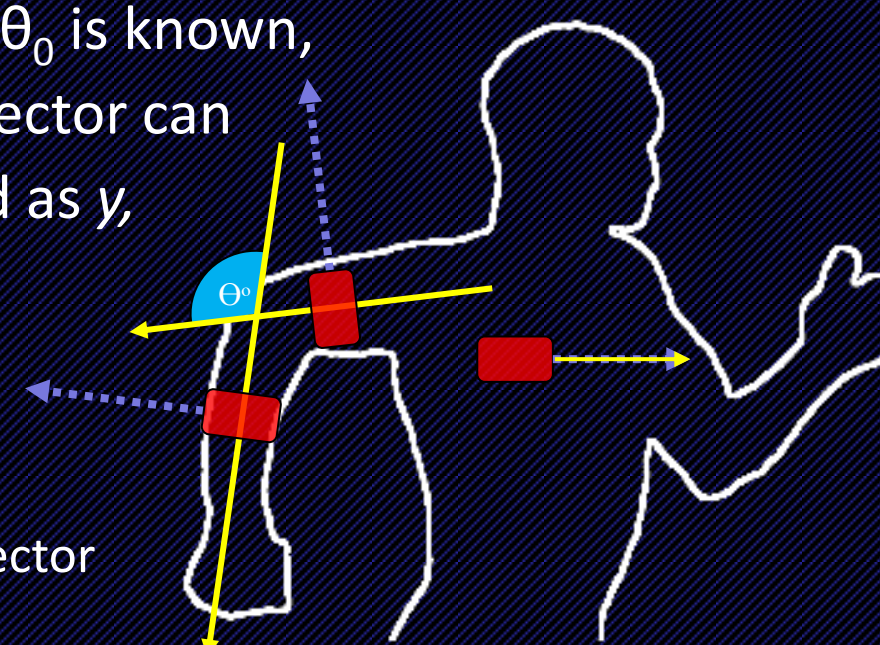
Joint Angle

Movement is a result of muscular force exterted on pliable joints, indicating that the angle of relevant joints at any time describe the static position of a particular limb.

Acceleration occurs as a result of all forces acting on an object (https://physics.info/motion/), suggesting that limb acceleration can predict limb angle.

The Diagram (*left*) details the importance of correct technique and suggests potential sites to focus angle calculation.

BBC Micro:Bit

Low-cost, programmable μ-controller designed with a Nordic-nRF51822 CPU to introduce children to Programming through block-coding. Advanced scripting can be undertaken using C++, Python, etc. through the mbed compiler.

Features:

- Accelerometer,
- Magnetometer,
- Bluetooth LE/ Radio,
- LED display/UI,

http://microbit.org/guide/features/
https://os.mbed.com/platforms/Microbit/
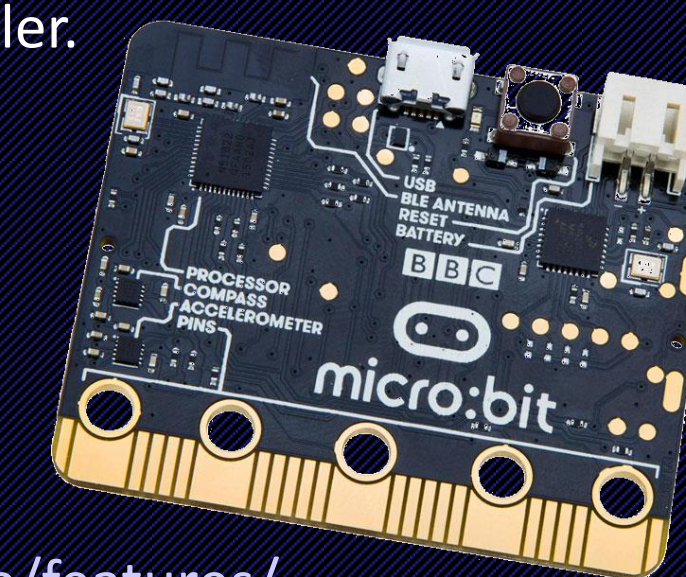
Android Studio

Open-source development environment to design, test, and implement Android applications.

- Java coding environment,
- GUI design (XML),
- Use device CPU for GUI Computation/Calculation,
- Allows Access to Device's Bluetooth Capabilities,

https://developer.android.com/studio/install