Motion Detection over WiFi

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Motion Detection using a WiFi network

- Use WiFi network to detect motion of a body through an area.

Motivation

- More and More sensors every day
- If we could find a way to eliminate some of those using the many wifi networks that already exist
- Very large pre-built infrastructure
- Think about different sensor possibilities
    - Counting bodies in a room
        - could eliminate the light motion detector
    - Some kind of tracking
        - perhaps through stores
    - even more reach sensing like temperature or somehow reading heartbeats

smart bulbs already have some sort of communication signal

How

- Have a stationary wireless access point and a wireless device
  - Ordinary router
  - Raspberry Pi
    - WiFi Chip on laptop was too good
- Continuously poll for the signal strength from the raspberry pi
- Using variance based detection algorithm
  - No need for baseline because the variance measures the difference from the average.
  - Spikes of motion will stabilize after a time

Detection Algorithm

$$X_i > thresh$$

$$\mu_n = \frac{1}{N} \sum_{i=n}^{n+N-1} x_i > thresh \qquad i = 0, 1, 2, ..., M \quad n = 0, 1, 2, ..., M - N$$

$$N > 0 \qquad N + n - 1 < M$$

$$\sigma_n^2 = \frac{1}{N} \sum_{i=n}^{n+N-1} (x_i - \mu_n)^2 > thresh \qquad i = 0, 1, 2, ..., M \quad n = 0, 1, 2, ..., M - N$$

$$N > 0 \qquad N + n - 1 < M$$

Results/Demo

- It seems to work pretty well as far as detection motion on a human's scale (won't detect a fly, might detect a hand wave, will detect a person walking through) in the 1 meter distance that I decided on initially
- I was not able to devise a convenient way to empirically test its performance so my results are anecdotal.
    - I would have to have an application to test for. For instance detecting someone walking through a doorway. Then I could walk through the doorway multiple times and see how many times it detected correctly. However there are too many variables to control for (ie. different clothing, different body size, walking speed)

Improvements

- Make a more efficient program
  - Program could be much more efficient with c or some other programming language.
- Different programming language would help with making a more robust detection algorithm (match filter, GLRT, etc.)
  - scripting can’t do too much in terms of math operations

Possible Future Work

- Positioning system with device
  - Be able to tell how far away from the access point
  - Be able to triangulate a position if there are 3 or more routers
- Device-less positioning system
  - Same function as before but with no device ie. phone.
  - Will work by measuring between access points instead of device and access point
  - May require phase data instead of strength data
- Tracking system
- Smart bulb that does motion sensing with its communication signal

Questions