Where Communication Meets Healthcare

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Why is a Wireless Center Talking About Healthcare?

- Communications is essential to health at many levels:
  - Individual patient data is needed for managed care
  - Realtime multimodal and multipatient data is needed for smart health
  - Lifestyle management will play an increasing role in addressing diseases
  - Many diseases are the result of breakdown in biological communication pathways

- Smart Health needs 5G:
  - The patient will be mobile!
    - *Preventative and sustained, personalized care*
    - *It will take a village: there is knowledge in the village!*
    - *Deep learning will lead to better predictions and recommendations*
  - The communication fabric will be the infrastructure across which data will be delivered to the cloud and deep analytics!

- The patient needs better data for analysis
  - There are new sensors being developed that will make new data available for analysis
  - Critical to partner the network with bio-sensors

The IoMT and Smarth Health is really about "DATA"

- Smart healthcare is about the DATA and closing the loop!!!
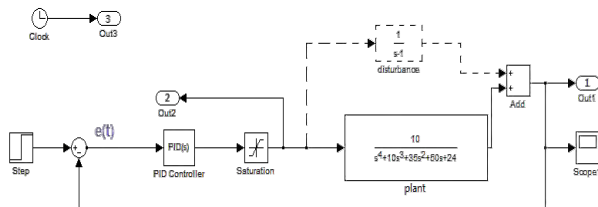 Many communications challenges: latency, ubiquity and volume!

Needs…

+

And…

WINLAB is collaborating with industry to develop medical sensing, inference, and active monitoring technologies

Sensing Layer

PHYSICAL SENSORS
- <bodytemp :98.6°F>
- <bloodpressure: high>
- <insulin: bad>
- <hydration: low>
- <Tcell Assay: CD8+, CD4+>
- <other: location, voice, etc…>

EXTERNAL EVENTS
- <weather>
- <schedule>

SOCIAL FEEDS
- <family events>

WIRELESS LINK SIGNAL
- <signal: strength>

Inference Layer

Feature/Context Inferences

Behavioral/Correlation Inferences

Physical

Passive Location/mobility Inference
| |
| Location: kitchen |
| Speed: 1m/s |
| Activity: eating |

- Average walking speed? Any recent degradation?
- Does indoor atmosphere impact her balance?
- Any leading indicators before she falls?
- How is hydration correlated with historical data?
- Does blood analysis suggest increasing diabetic risk?

Walking speed / Time / pressure
CDF / speed / Fall likelihood

Social

Passive Socialization inference
| |
| Activity: talking to 3 people |
| Duration: 15 minutes |
| Last time left house: 2 hours ago |

- Average socialization level?
- Any recent degradation?
- Social/not social compared to peers?
- What factors affect her social interaction?

Cognitive

Passive Cognitive level inference
| |
| Location: leaving kitchen |
| Stove: on |

- How often does she forget? Taken pills lately?
- Any recent degradation?
- Does she forget more than peers?
- What causes her to forget more?

Wellbeing Management

Assessment

PHYSICAL — FAST, NORMAL, SLOW, TOO SLOW
SOCIAL — TALKS MORE, NORMAL, TALKS LESS
Cognitive

•Degradation alerts:
- Walked slower by 30% yesterday!
- Talked less by 80% last week!
- Forgot to take her pills last 3 days!

•Causal alerts:
- Low air pressure + slow paced walk → high fall likelihood
- Alone in Holiday → social withdrawal
- Glucose levels → diabetic shock

•Emergency alerts:
- Still in shower after 1 hour!!!