Towards Dependable Self-Powered Things for the IoT

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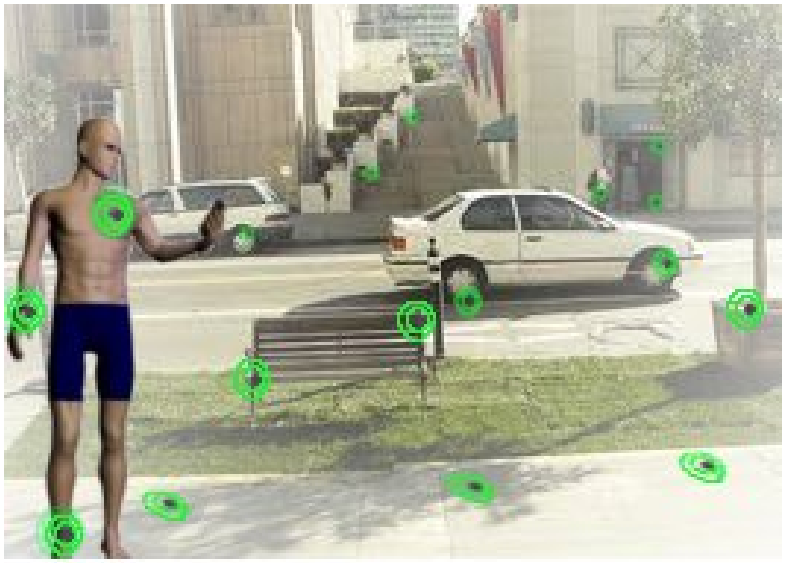
Self-Powered IoT

Envisioned scale of IoT demands self-powered operation

- 1 trillion "things" each with a 5 year battery life requires 548 million battery changes per day!



Device and energy harvester efficiencies depend on physical world dynamics

- Statically configured harvesters, circuits, and systems will provide limited dependability
- Even responding only to instantaneous conditions is sub-optimal

Requirements	Constraint
Small, wireless, long lasting	ULP operation
>1 trillion nodes	High energy harvesting
Vigilant monitoring	
Interact w/ humans & environment	Cyber-physical design and operation
Respond to system dynamics	

Profiling and Adapting to Physical World Dynamics

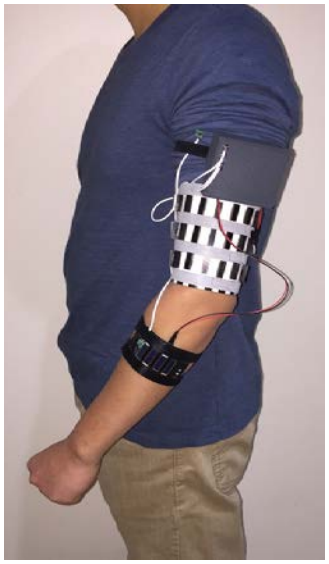
Profile physical world dynamics that impact device and harvester efficiency

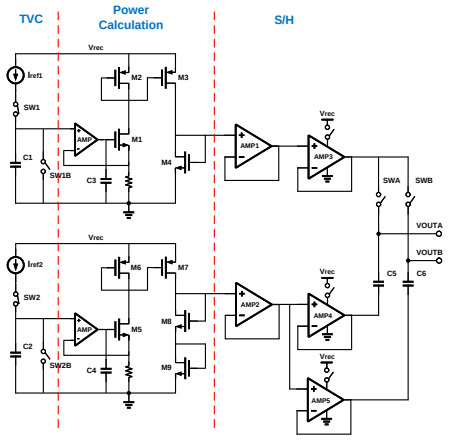
- Ambient conditions, motion, electromagnetic interference, human behavior, etc.

Dynamics models inform algorithms for dynamic system adaptation

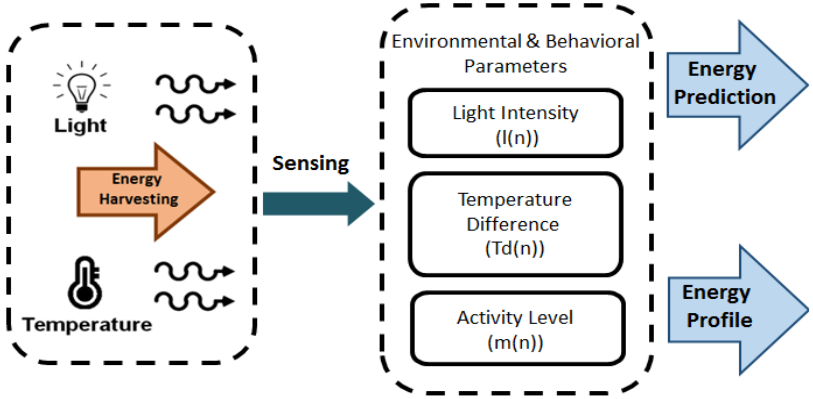
- Based not only on past and current conditions but also on **predictions** of future conditions

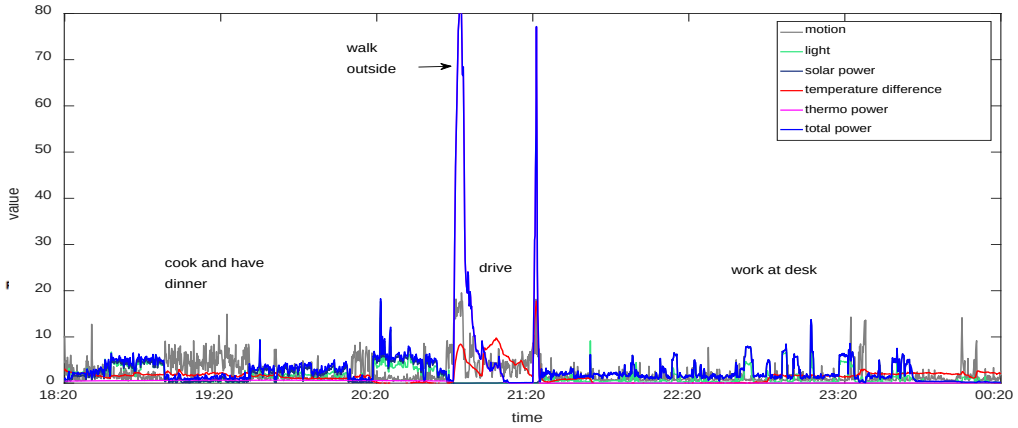
Innovations in ULP circuit operation and UHE energy harvesting to engineer and operate dependable self-powered things for the IoT

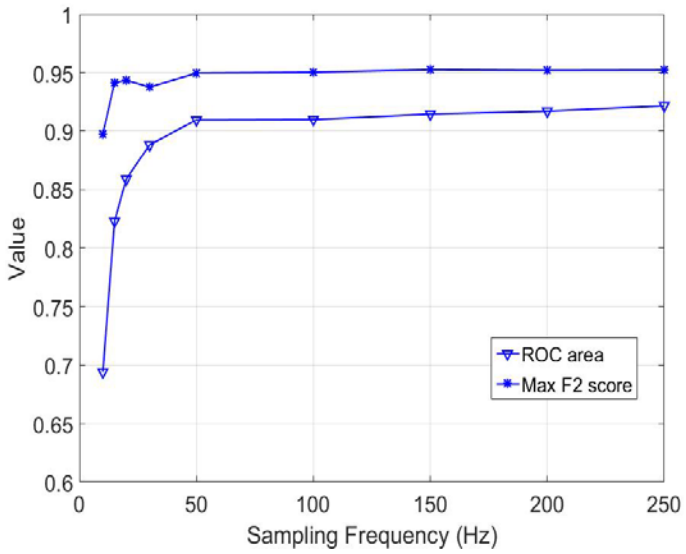




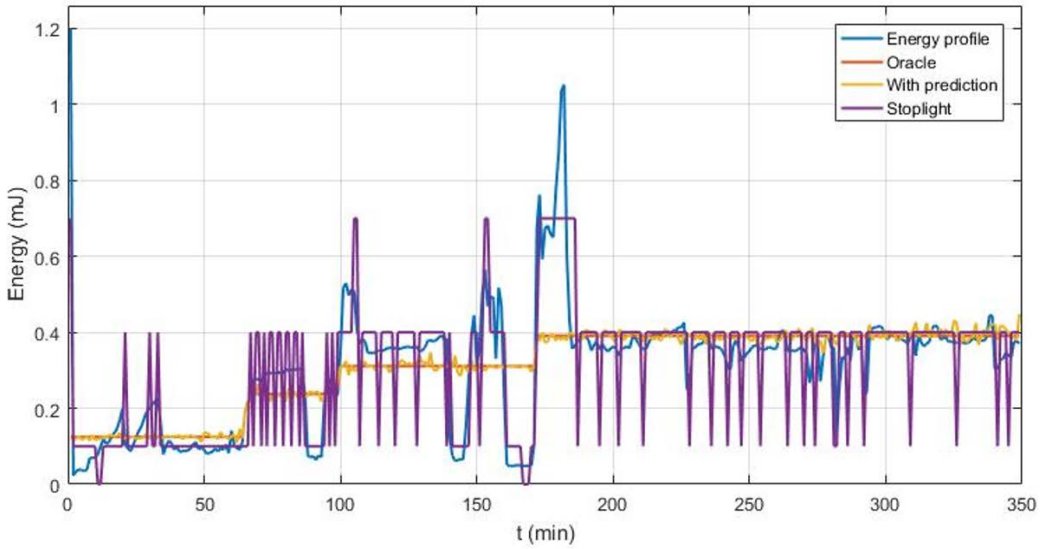
Dependable Self-Powered Operation







Atrial Fibrillation detection accuracy as a function of ECG sampling frequency defines quality cost function



Quality "cost" of DPM strategies given a harvesting profile:

Oracle: 130.99 Greedy: 140.20

Predictive: 131.06 Stoplight: 144.75