

# WattsUpDoc: Data Collection

Using Power Side Channels to Discover Malware on Embedded Medical Devices

Katarzyna Olejnik, Shane S. Clark, Kevin Fu



S.P.Q.R.  
<https://spqr.eecs.umich.edu/>

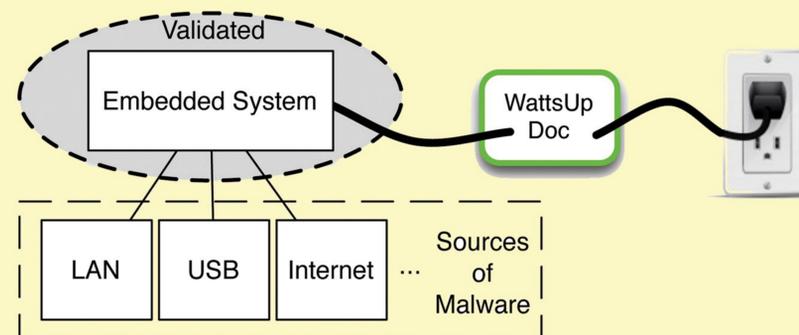


**Context:** Malware infections on medical devices and safety-critical embedded systems.

Conventional mechanisms — antivirus, firewall — do not apply:

- Device manufacturers prohibit software changes, including updates, on devices
- Using firewalls would require one per device: a maintenance nightmare
- Embedded systems cannot run antivirus software

Use WattsUpDoc system to monitor power consumption.  
Power data is analyzed by machine learning algorithms to detect anomalies.  
Alert users of abnormal behavior.



**Problem:** Need to acquire more power data.

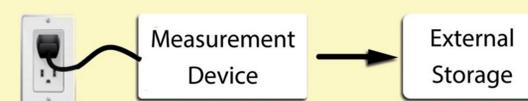
- **Equipment:** Agilent DAQ U2356A, \$2,000
- **Deployment:** Requires expert setup, PC
- **Time:** Requires continuous monitoring



Expense and time investment make simultaneous deployments infeasible.

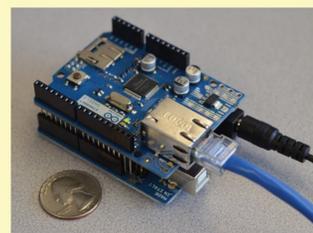
**Goal:** Create a new data collection system.

- **Cheap:** Easy to build and deploy many simultaneously
- **Simple:** Setup should be quick and not require an expert
- **Long deployment time:** No human supervision. Streams data to external storage



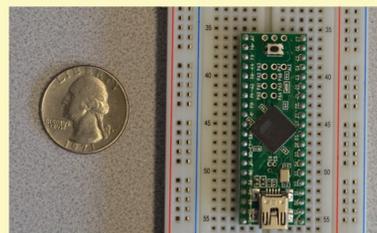
**Approach:** Use existing embedded platforms.

Low-cost, plug-and-play functionality, small size. Send data to remote machine for storage and analysis  
The two best-performing candidates:



**Arduino Uno with Ethernet Shield**

- Sampling rate: 35 kHz, 10-bit precision
- Data transfer: Ethernet
- License: Open source
- Cost: \$50



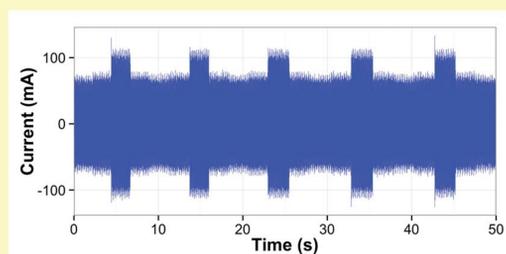
**Teensy++ 2.0**

- Sampling rate: 71 kHz, 10-bit precision
- Data transfer: USB
- License: Proprietary
- Cost: \$24

**Next steps:** Test in the field.

Looking for collaborators and more devices to measure

- Test how data quality compares to DAQ, and how WattsUpDoc performs on a wider range of devices



- Data collected will be used to further improve WattsUpDoc system
- Arduino and code created for this project are open-source, allowing open access to a low-cost DAQ solution

<http://www.github.com/kolejnik/arduino>

Pharmaceutical compounder running Windows XP Embedded



Strategic Healthcare IT  
Advanced Research  
Projects on Security

