Low-cost, pervasive sensing modifying existing wireless infrastructure

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Broad research portfolio
Keeping TABS on things: Tag Antenna-Based Sensing Concept
Anemia: The problem

Lack of O₂ intake due to reduced RBC count

- Impairs cognitive and physical development
- Indicative of deeper issues
- Cumbersome detection

Pregnant Women

- 41%
- 59%

Preschool children

- 47%
- 53%
Detecting anemia using paper

\[ \text{RBC count} \approx \frac{dL}{dt} \]
Sample Blood

Plasma Flow

Zone where plasma separates from RBCs
Test results
Summary

- RFID-based anemia detection sensor
- 20-40% hematocrit count
- Low-cost
- Quantitative measurement
- Seamless integration with electronic health records
Other modalities

- Antenna
- IC
- Monopole probe
- Sand
Perceiving the world with your smartphone

Source: qualcomm.com
Monitoring wheel imbalance

- Varied degree of severity
- Indicative of larger issues

Source: sine.ni.com
Can we do better?
PCA-FFT features: Decision tree

```
12 Hz (y:0.0023)
```

- 0
- 1
PCA-FFT	decision	tree	computed	features
Algorithm: pca

Bar chart showing the count of accuracy % bins.
Insights

- Accurate imbalance detection with smartphone
- Detects imbalance which itself was “imperceptible” to test drivers
- Robust algorithm works on 2 vehicles of different make/model
Other modalities

- 5 state tire pressure classification
- Engine misfire
- Air filter quality
Conclusions

- Intelligence shift to peripheral devices
- Movement from reactive to proactive diagnostics
- Leveraging advances in computational hardware
  - Off board computation is easily upgradable
  - Cost savings from reducing excess wiring
Final words ..

- ‘Extensibility’ enables cheap, pervasive sensing
- Diverse applications
- Opportunities
  - Creative antenna designs
  - Electrically responsive smart materials
  - Advancements in peripheral computing
  - Machine learning techniques