

CSC9006: Real-Time Systems

Lecture: Internet of Things

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References

- Chapter 13 in the textbook → Kopetz, Hermann. Real-Time Systems: Design Principles for Distributed Embedded Applications. Springer; 2nd ed. 2011 edition.
- R. T. Hasanat, M. Arifur Rahman, N. Mansoor, N. Mohammed, M. S. Rahman and M. Rasheduzzaman, "**An IoT based Real-time Data-centric Monitoring System for Vaccine Cold Chain**," 2020 IEEE East-West Design & Test Symposium (EWDTS), 2020, pp. 1-5, doi: 10.1109/EWDTS50664.2020.9225047.
- Ashvin Ashok, Michael Brison, Yann LeTallec, **Improving cold chain systems: Challenges and solutions**, Vaccine, Volume 35, Issue 17, 2017, Pages 2217-2223, ISSN 0264-410X, <https://doi.org/10.1016/j.vaccine.2016.08.045>.

Lecture outline

- Internet of Things (IoT) introduction
- IoT example: RFID technology
- IoT example: Cold chain monitoring systems for vaccine delivery
- QR code + SMS in Taiwan under COVID-19

The vision of the *Internet of Things*

- Billions (or trillions) of *smart objects* that improve technical and social issues that are related to size.

– Example: IoT for car maintenance (and marketing)

<https://www.youtube.com/watch?v=QSIPNhOiMoE>

- Drivers for IoT

– Technology push forces

– Technology pull forces

- Forerunner of the IoT: RFID technology

IoT applications

- Energy saving (?)
- Physical security and safety
- Monitoring, controlling, and maintaining industry assets
- Medical issues (e.g., the TUG test)

IoT for energy saving

- HVAC systems
- Lighting control
- Virtual meeting (?)
- Demand response

IoT for physical security and safety

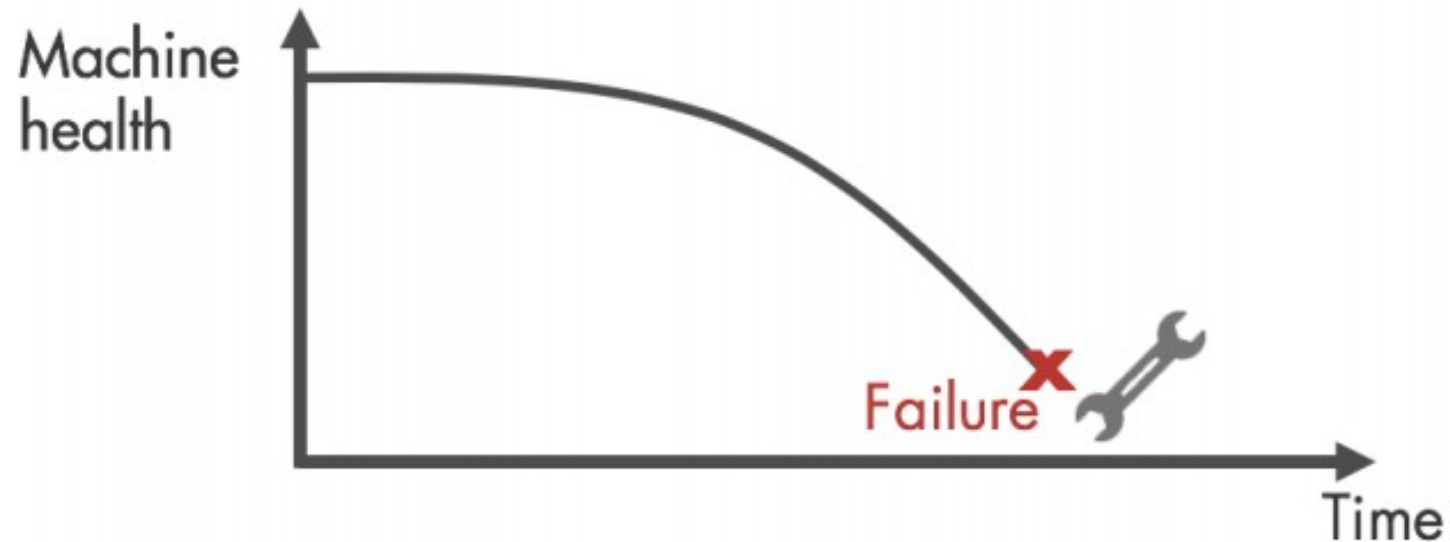
- Building access control
- Public space surveillance
- Car-to-car / car-to-infrastructure coordination

Industry IoT

- Predictive maintenance
 - Compared to *reactive* maintenance and *preventive* maintenance

Reactive Maintenance

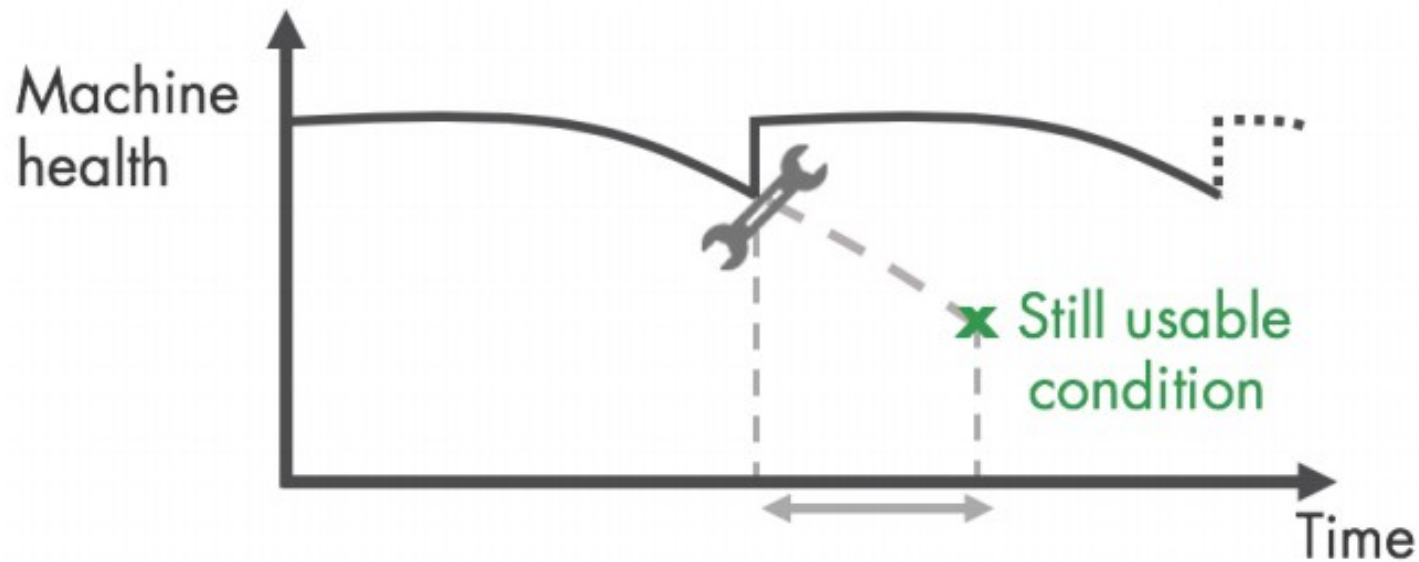
- Machine are repaired or changed only after failure.



<https://ww2.mathworks.cn/content/dam/mathworks/ebook/predictive-maintenance-ebook-part1.pdf>

Preventive Maintenance

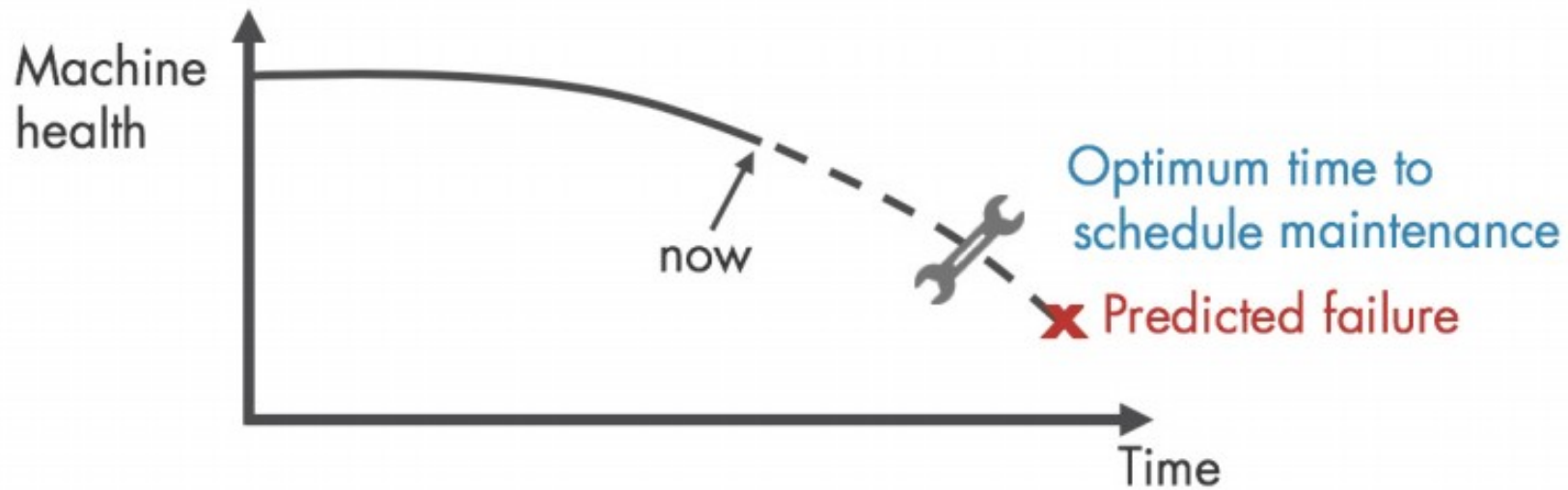
- Machines are repaired or changed periodically
-
- But it might be a waste of resources
-
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<https://ww2.mathworks.cn/content/dam/mathworks/ebook/predictive-maintenance-ebook-part1.pdf>

Predictive Maintenance

- Knowing the predicted failure time helps engineers find the optimum time to plan maintenance schedule



<https://ww2.mathworks.cn/content/dam/mathworks/ebook/predictive-maintenance-ebook-part1.pdf>

Medical IoT

- Also known as IoMT (Internet of Medical Things)
- Health monitoring
- Precision drug delivery
- The TUG test (Timed Up and Go)

Technical issues of the IoT

- Internet integration
- Naming and identification
- Energy-efficient wireless access to smart objects
 - Bluetooth
 - ZigBee
 - NFC

The RFID technology

- Limitation of optical bar code and QR code
- RFID tag
 - Passive and active
 - EPC: Electronic Product Code
- 96 bits long

RFID security

- Authenticity
- Privacy (clandestine reading)
- Denial of Service