

Evaluation Criteria

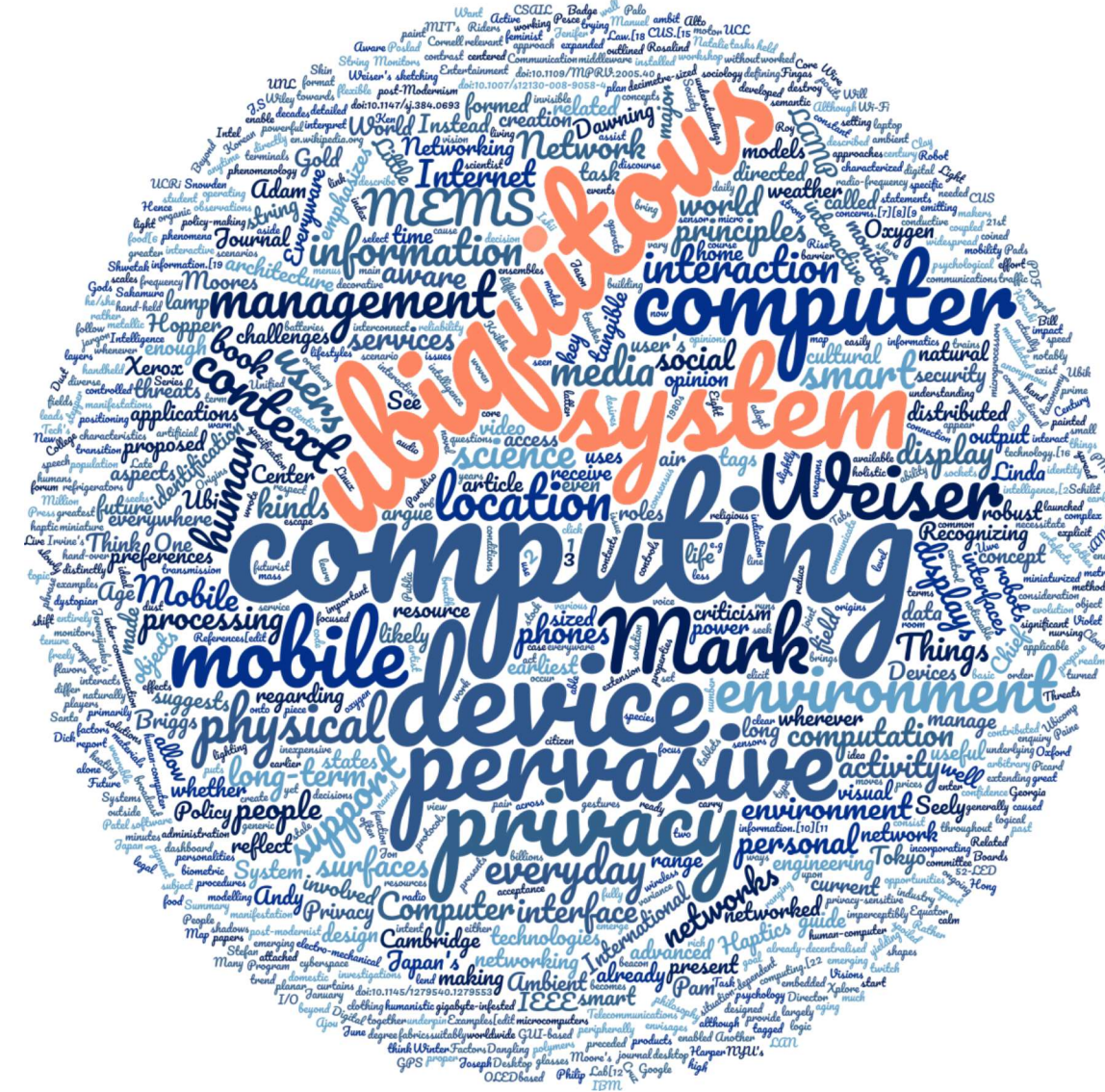
1. Independent design and implementation
2. Application of gained knowledge
3. Use of new microcontroller functions
4. Focus on energy efficiency
5. Proper coding and documentation
6. Pitch Presentation



Pitch Presentation

1. Concept and approach
 2. Design and implementation
 3. Achieved power consumption
 4. Experiences and struggles
- Keep it simple and catchy!
 - No time for an introduction, directly start with the pitch.
 - The presentation has to be finished within 3 minutes.





Scenario

- Bridges from concrete
- Deterioration and weathering
- Regular inspection and maintenance
- Very expensive

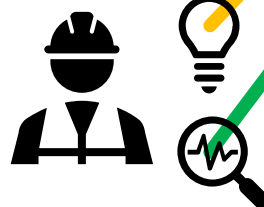


Reference: <https://www.astm.org/standardization-news/sites/default/files/GettyImages-1022530806.jpg> [2020-06-21] & https://www.dailynews.com/wp-content/uploads/migration/2017/2017_LOCAL1_170229976_AR_0_XZIVBUFKAMSN.jpg [2020-06-21] & https://www.schwaebische.de/cms_media/module_img/406/203232_1_opengraphpremium_103232_1_org_103232_1_org_B82212292Z.1_20100419184306_000_GC17G47R.1_0.jpg [2020-06-21]

Scenario

- Smart Dust – small MEMS devices
- Measurement on the fly
- Remote sensing of mechanical stress and humidity (water inle
- Wake-up transcei

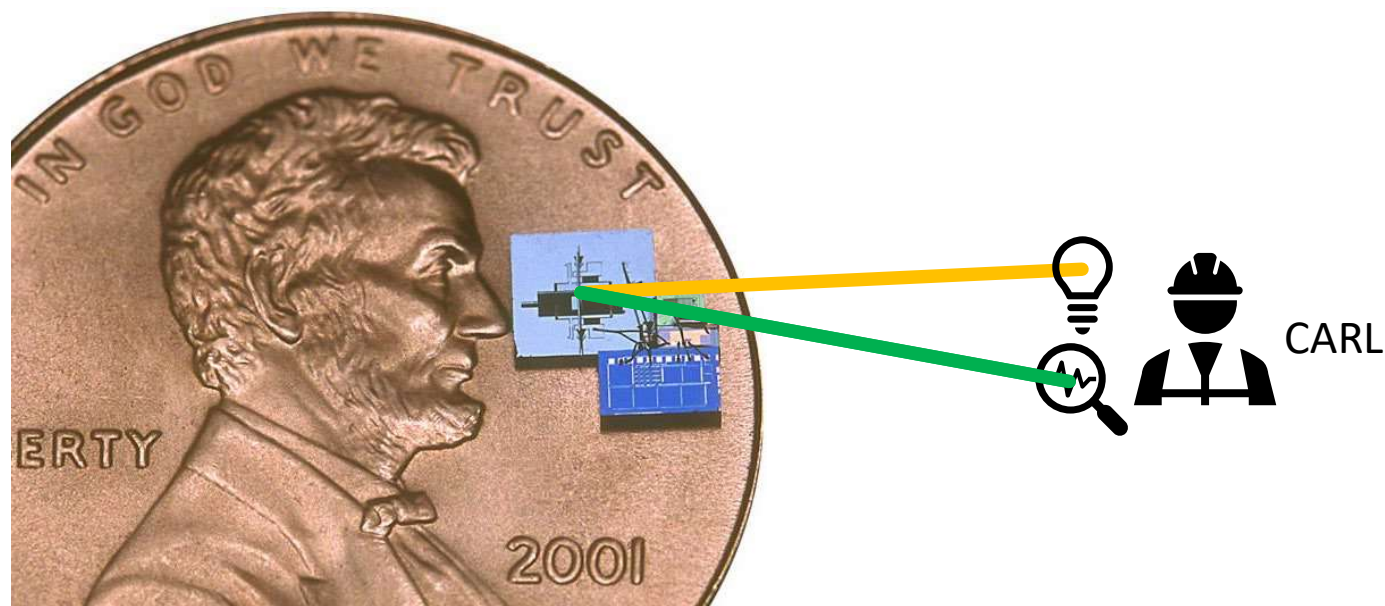
CARL



Reference: <https://www.astm.org/standardization-news/sites/default/files/GettyImages-1022530806.jpg> [2020-06-21]

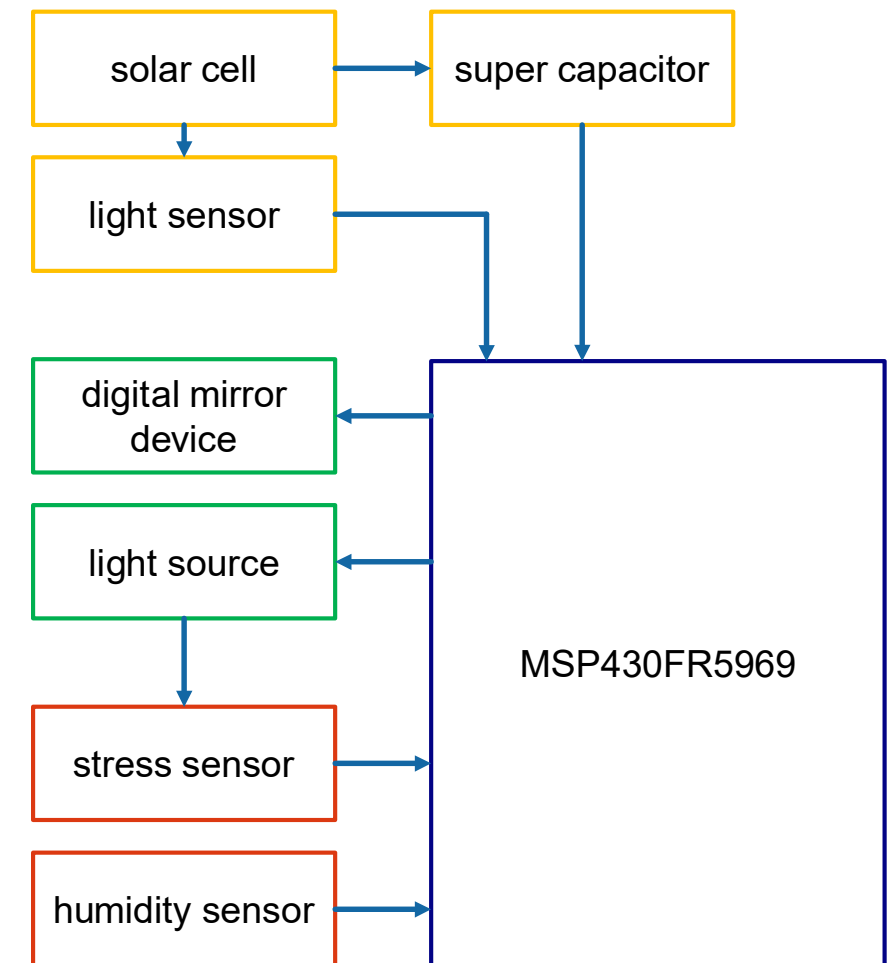
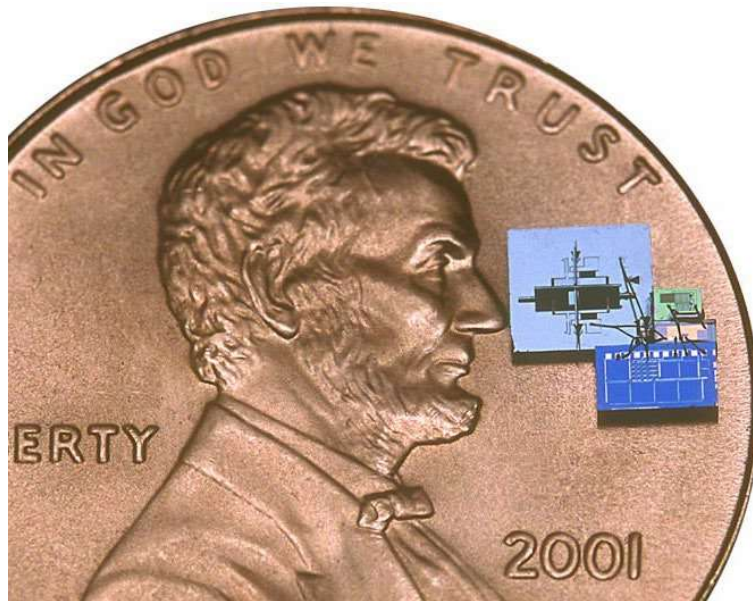
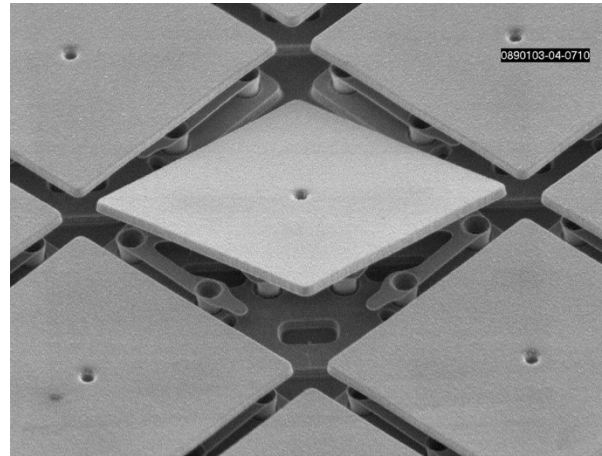
Device's Operation

- Sleeping
- Charging & wake-up
- Acknowledgement
- Stress & humidity measurement
- Transmission

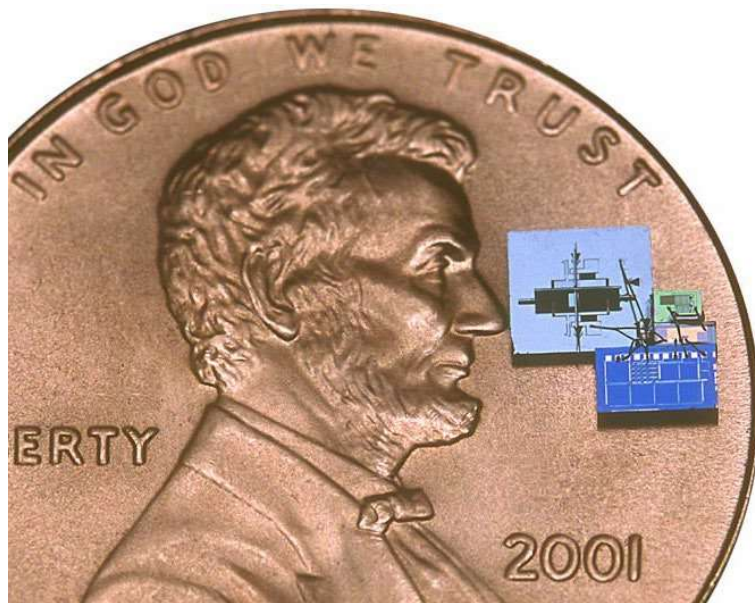


Reference: An Autonomous 16 mm³ Solar-Powered Node for Distributed Wireless Sensor Networks, Warneke, IEEE Sensors, 2002

Reference: <https://spectrum.ieee.org/image/MjkwOTU2MA.jpeg> [2020-06-22]



Reference: An Autonomous 16 mm³ Solar Powered Node for Distributed Wireless Sensor Networks, Warneke, IEEE Sensors, 2002



0: not | 1: reflecting

LED2

0: off | 1: stress test

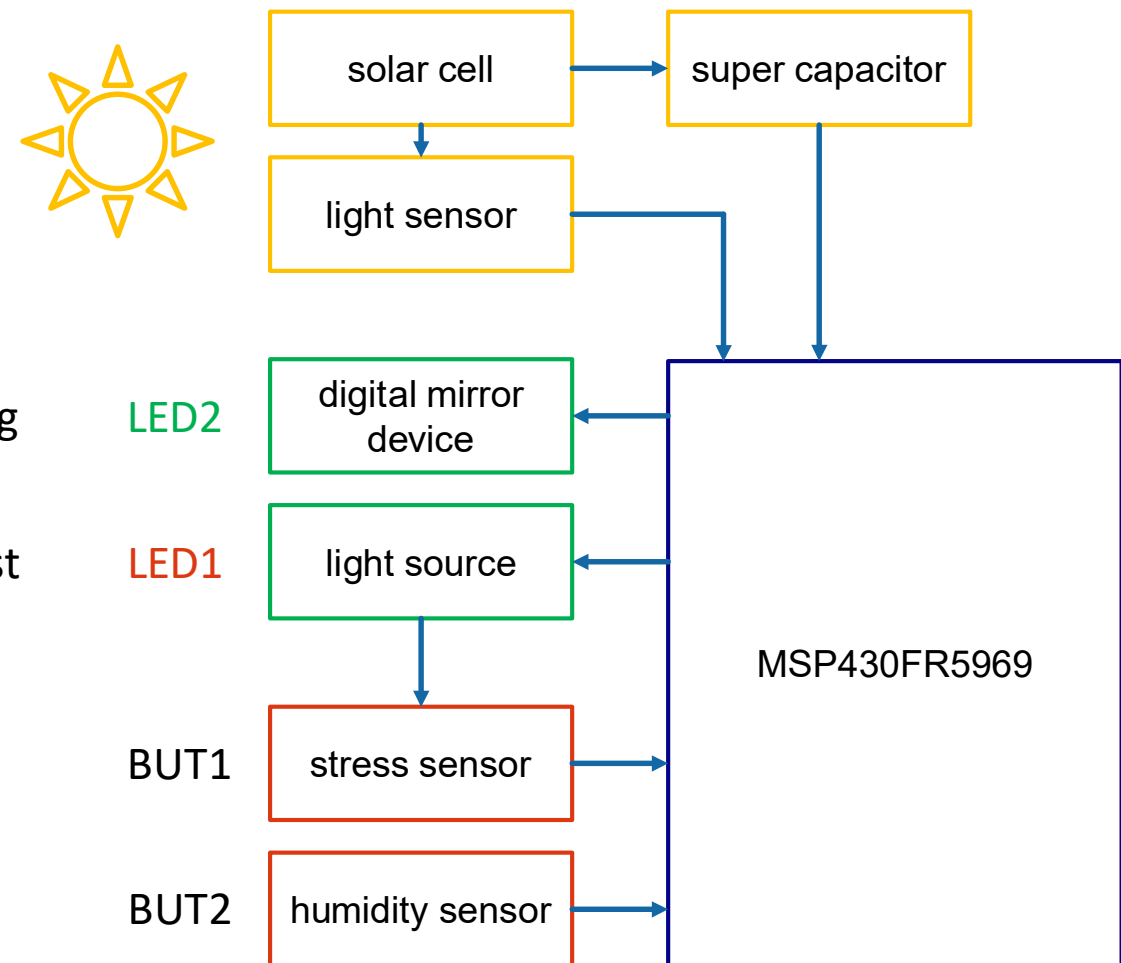
LED1

0: incident | 1: fine

BUT1

0: incident | 1: fine

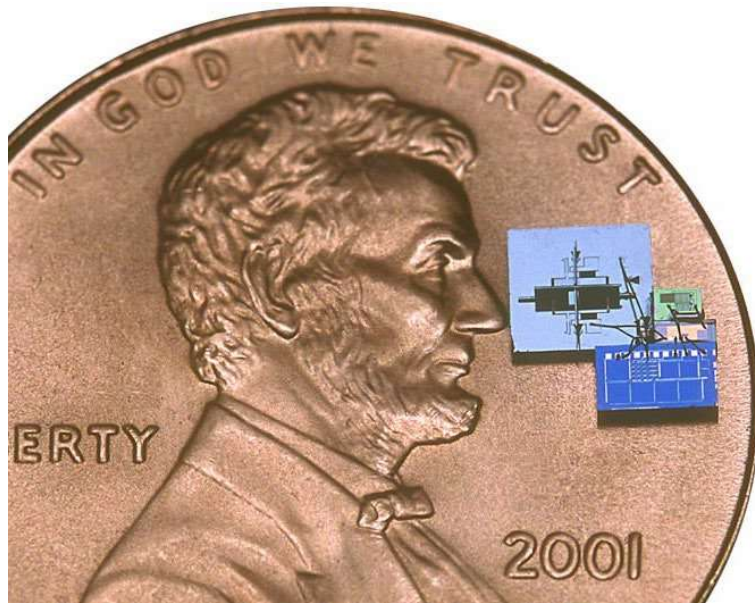
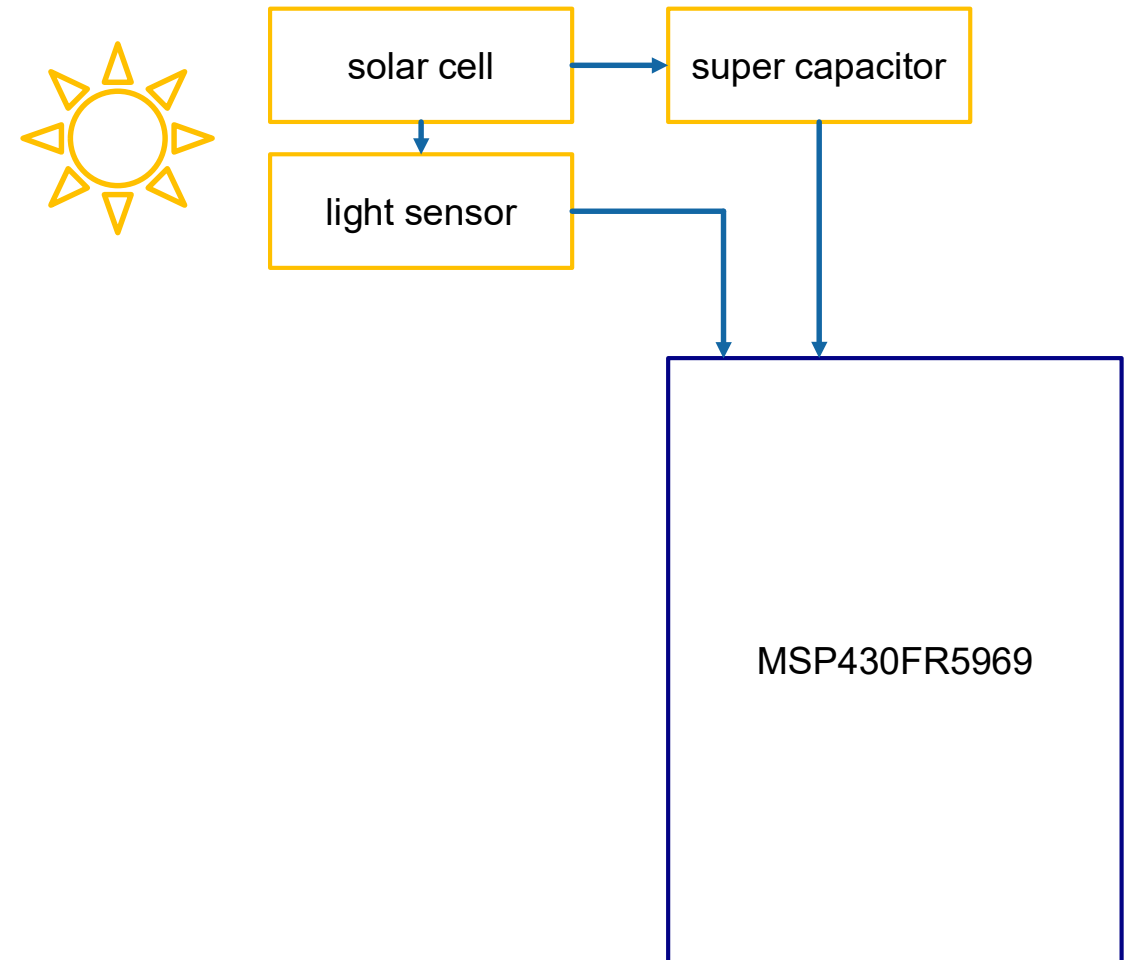
BUT2



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Sleeping

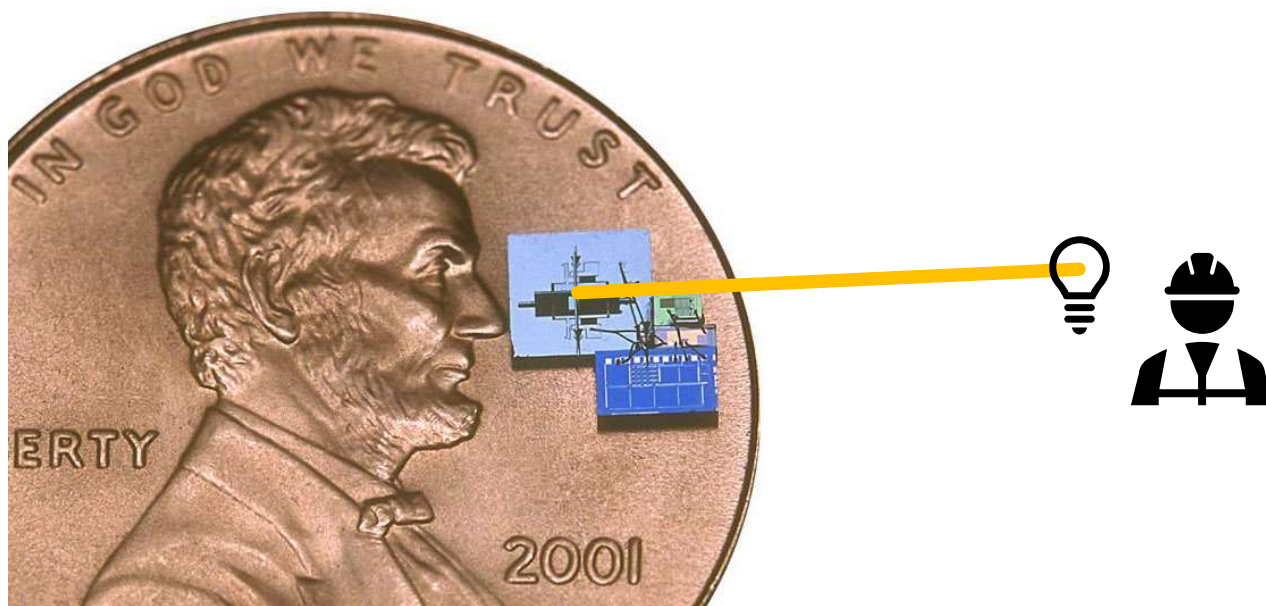
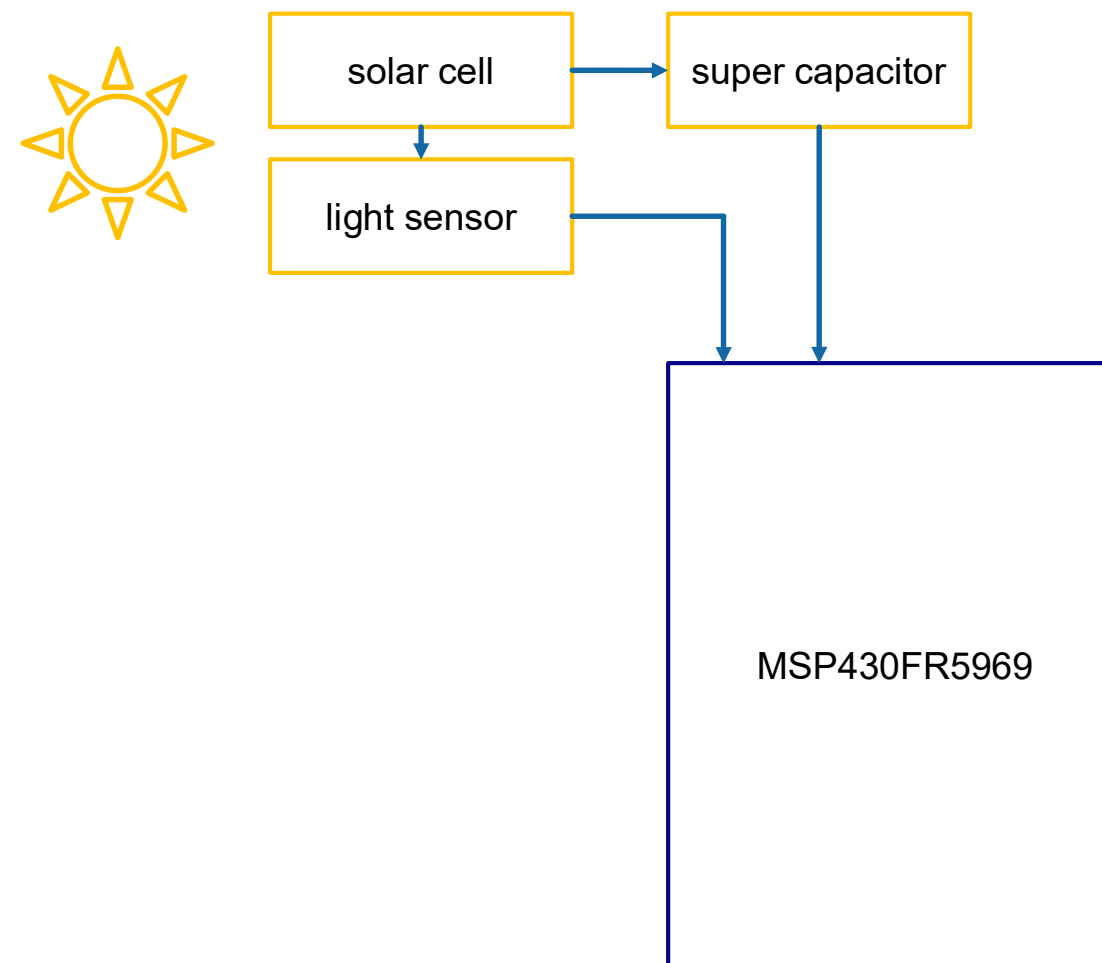
- Lowest energy consumption possible
- Check for light at least 1/s



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Wake-Up

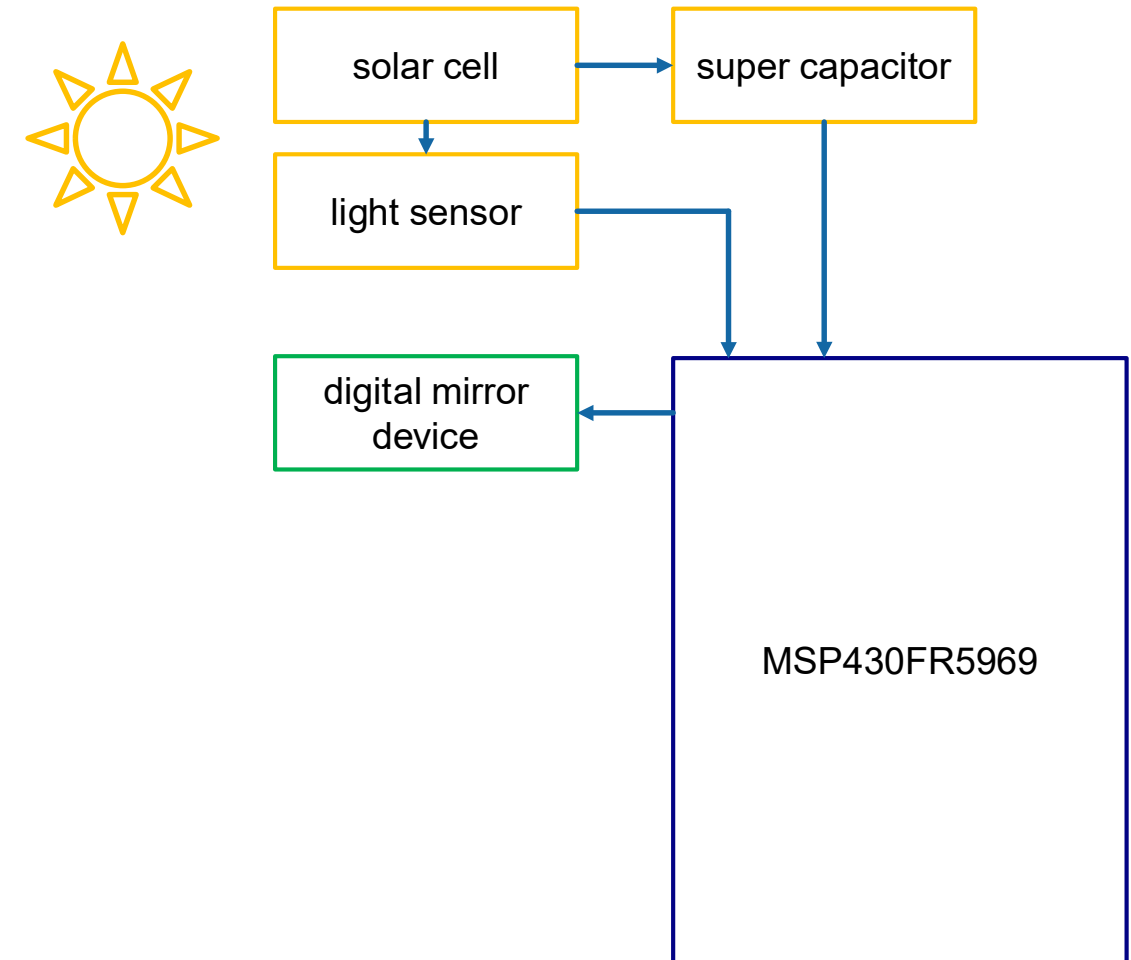
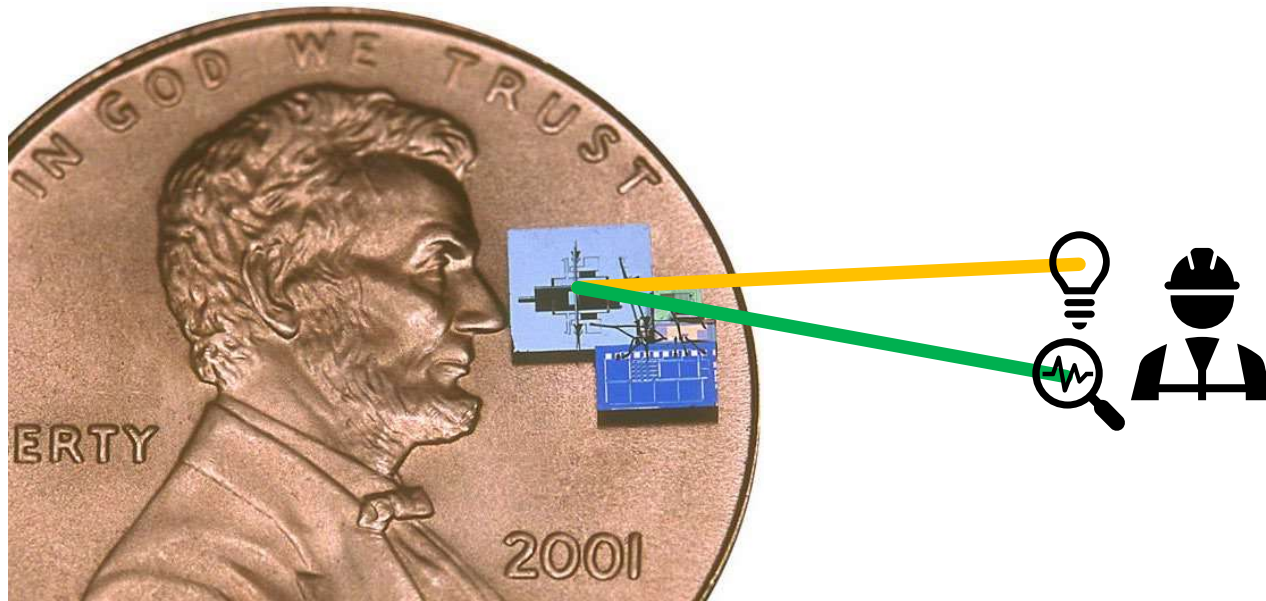
- 3 s of continuous bright light ($> 15 \text{ lx}$)
- Detection of the preamble (0b01101010 MSB, 0.5s/bit, $\pm 20\%$)



Reference: An Autonomous 16 mm³ Solar Powered Node for Distributed Wireless Sensor Networks, Warneke, IEEE Sensors, 2002

Acknowledgement

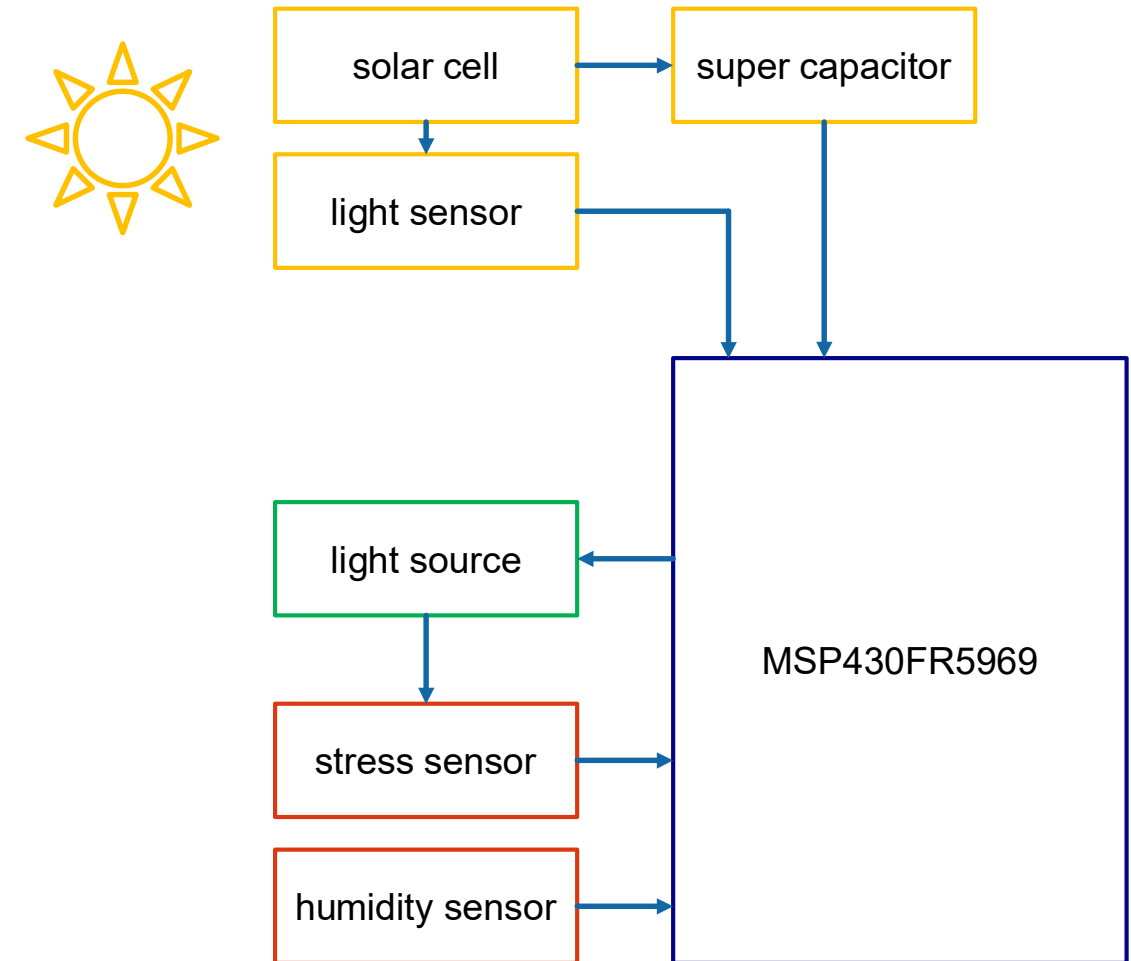
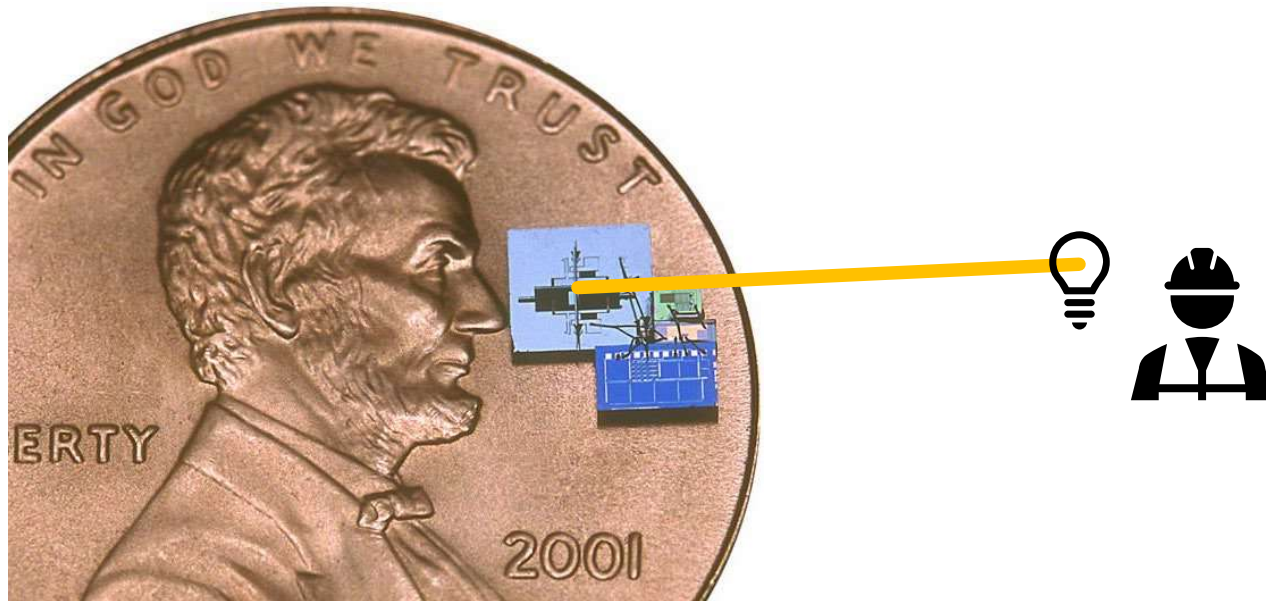
- Digital mirror device
- Reflection for 250 ms



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Stress & Humidity Measurement

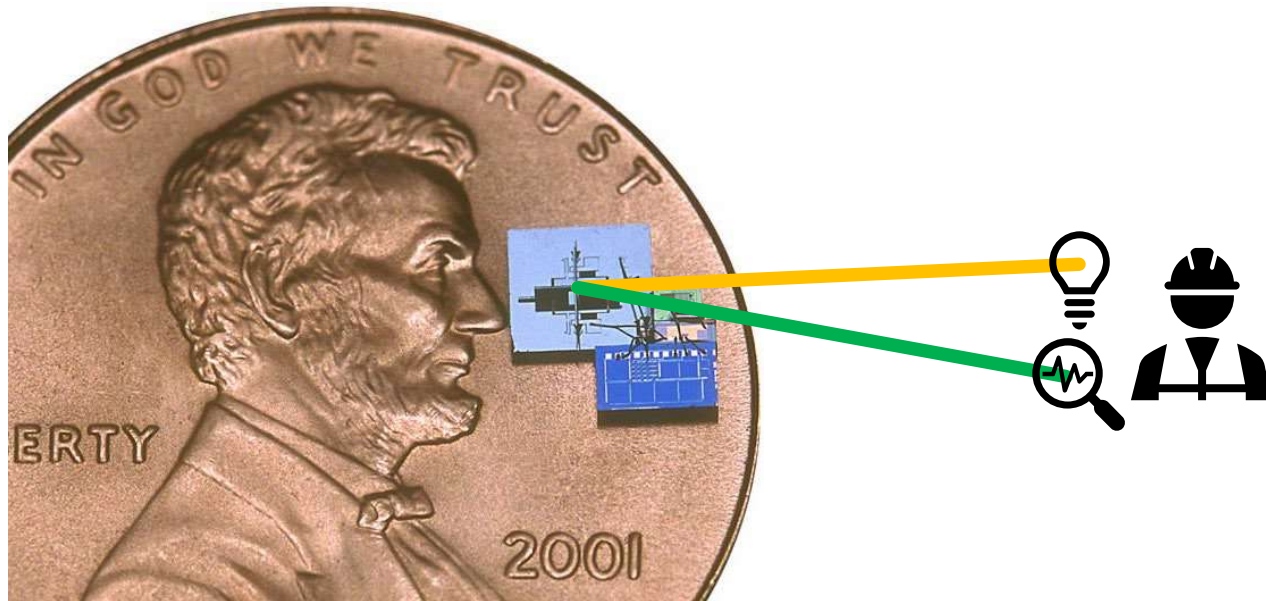
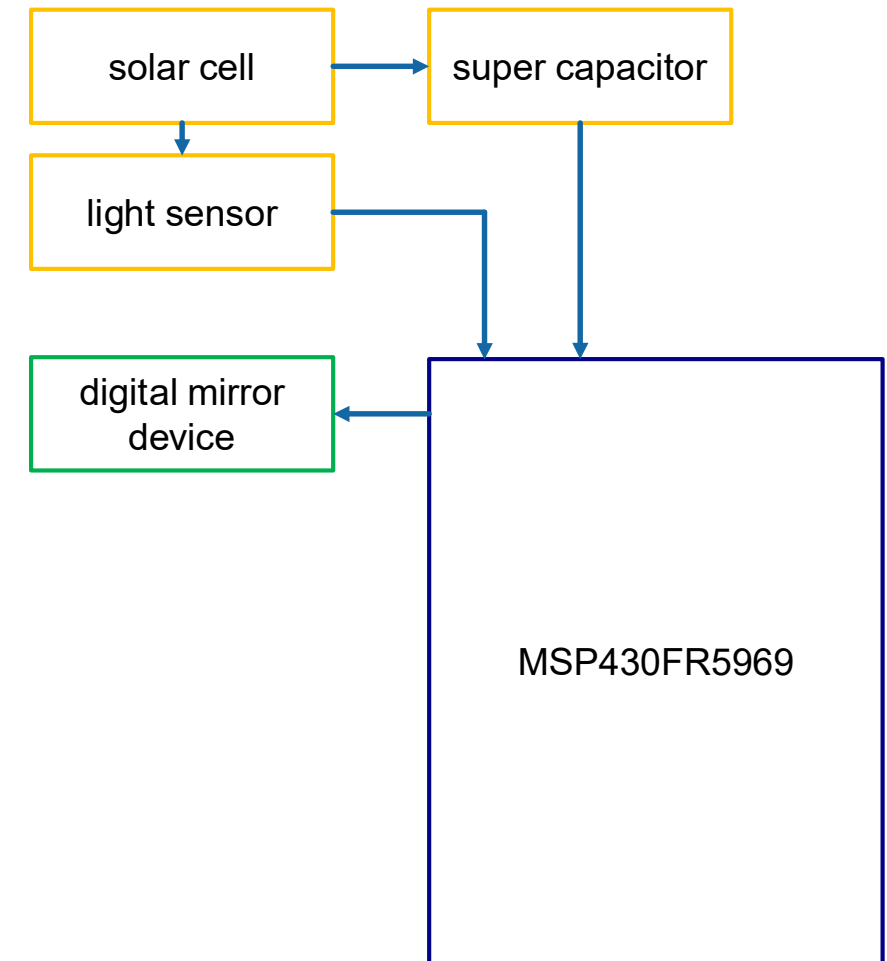
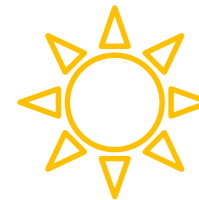
- Check that light is still present
- Turn light source on for stress test (± 10 ms)
- 8 samples of stress sensor
- 8 samples of humidity sensor



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Transmission

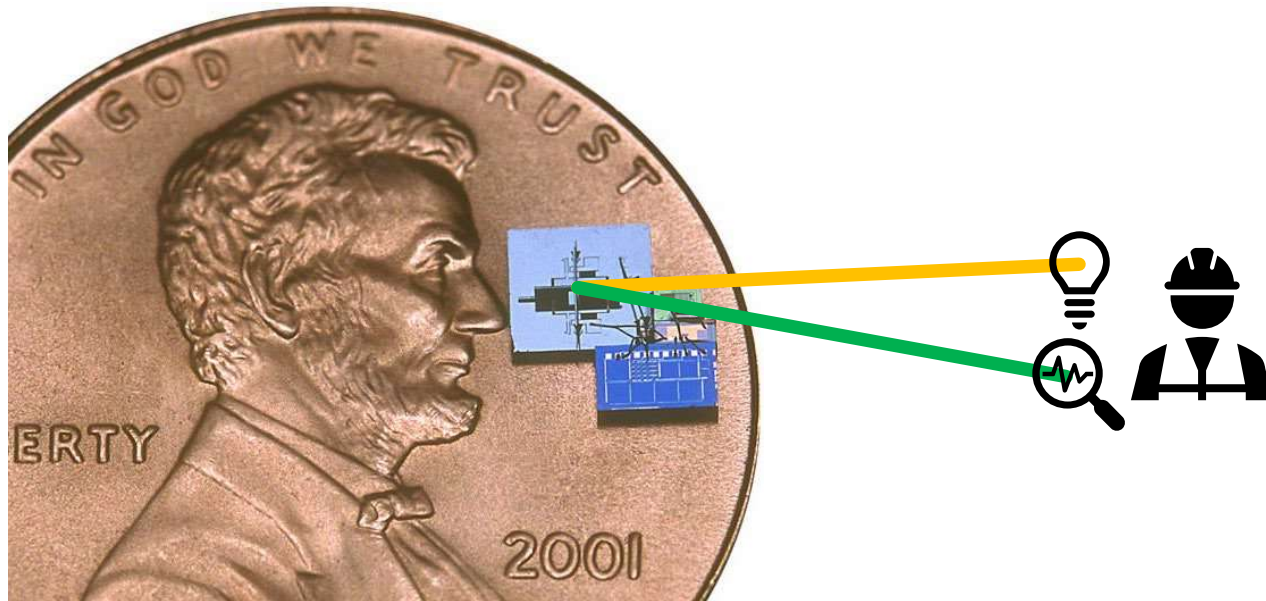
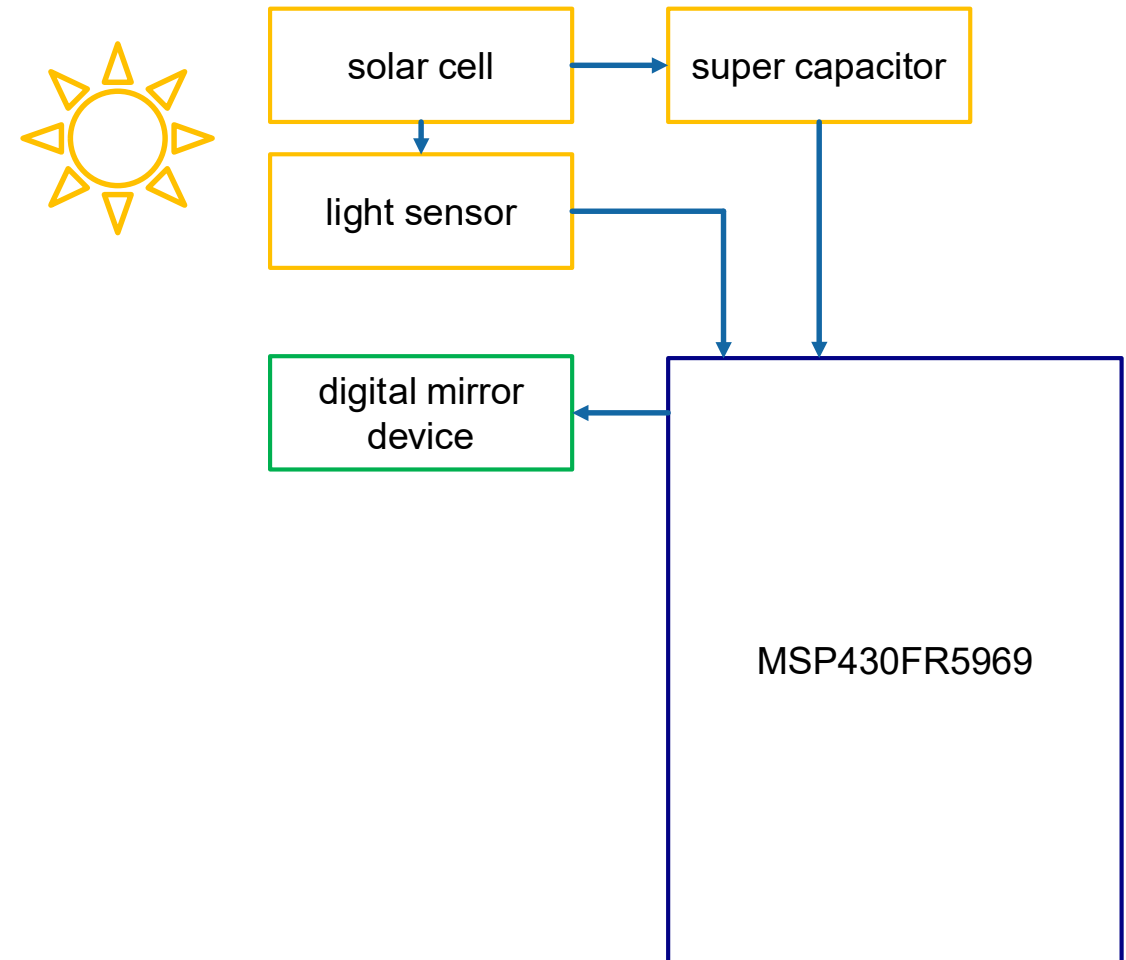
- Check that light is still present
- Transmission of preamble (0b10010101 MSB)
- Transmission of data [humidity MSB | stress MSB]
- 0.5s/bit with 0: 25% duty cycle | 1: 75% duty cycle



Reference: An Autonomous 16 mm³ Solar-Powered Node for Distributed Wireless Sensor Networks, Warneke, IEEE Sensors, 2002

Transmission Error

- Continuously check that light is present
- Light connection lost: DMD reflection for 1 s



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Simulation and Testing

1. Test your application with a flashlight
2. Modulate the light beam with your hand
3. Measure the energy consumption using EnergyTrace/++
4. Charge the on-board super capacitor (100 F) with the USB cable
5. Test how long your implementation runs with a single charge



The evaluation board does not have a solar panel, you need to charge the SuperCap with your computer:
<http://www.ti.com/lit/ug/slau535b/slau535b.pdf> (chapter 2.4.5, p. 19)