SELF-SUSTAINABLE IOT WIRELESS SENSOR NODE FOR PREDICTIVE MAINTENANCE ON ELECTRIC MOTORS

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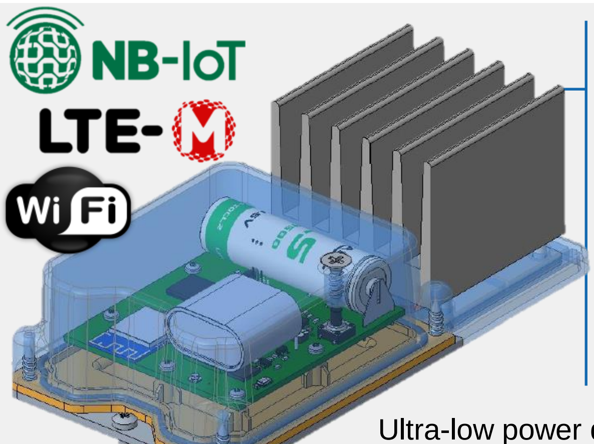
1 Introduction

Unexpected equipment failure is expensive and potentially hazardous for workers. Periodic inspections and maintenance aim to limit unplanned production downtime, costly replacement of parts and safety concerns. On the other side, predictive maintenance techniques can monitor equipment as it operates, anticipating deterioration and incoming breakages, enabling just-in-time services at reduced operational costs.

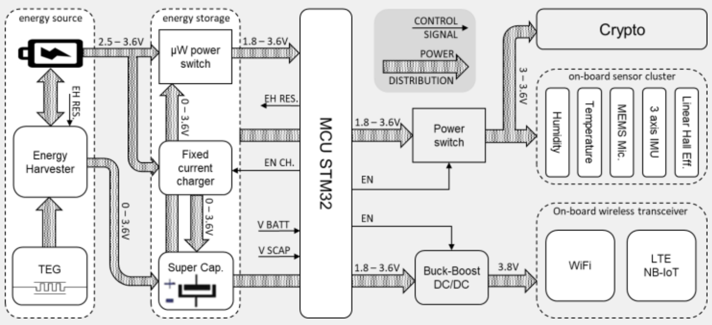
2 Self-sustaining and smart sensor node



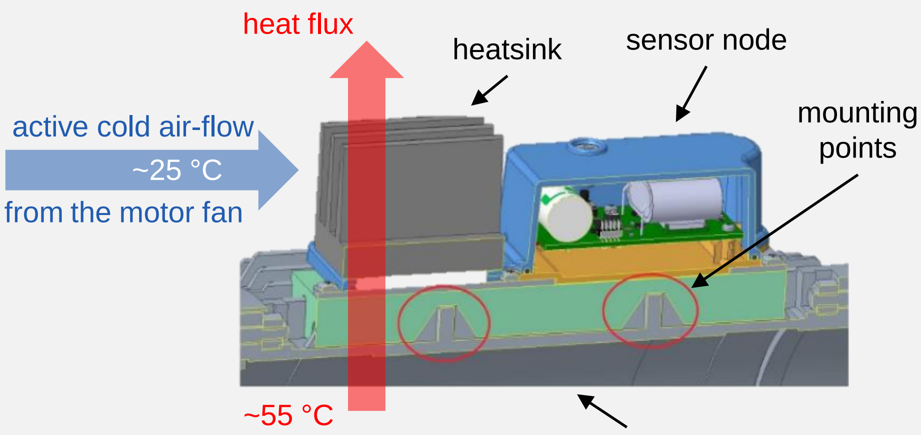
On-board sensors:
- Temperature 0.1 °C accuracy
- Humidity 1% accuracy
- 3 axial accelerometer 26 kHz – noise 75 μg
- Microphone – 192 kHz
- Bi-axial magnetometer 0.01 G accuracy

Ultra-low power design supporting a non rechargeable **battery** and a **super-cap**

ARM Cortex M4 for on-board computing and classification



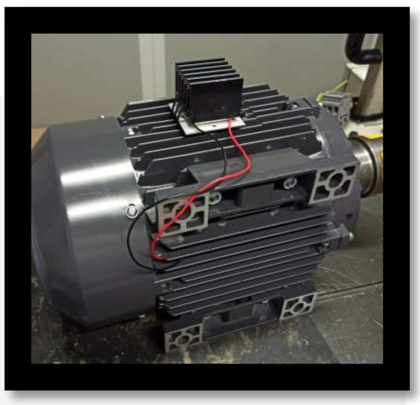
3 ThermoElectric Energy Harvester



4kW electric motor powered at 380V RMS 50 Hz. Room temperature 23 °C. 4x4 cm TEG element.

Pot [kW]	T. frame [◦C]	T. heat. [◦C]	ΔT	TEG [mW]
1.900	45.0	30.0	**15.0**	23.7
2.255	47.5	29.5	18.0	42.1
3.956	50.0	30.0	20.0	48.3
4.552	54.6	30.5	24.1	66.4
5.456	55.3	30.6	24.7	73.5
6.555	56.9	31.5	25.4	**77.3**

4 Results and Discussion



In-field test

The final prototype proposed in this paper was installed on an **4 kW** electric motor loaded by a **braked dyno**. The electronic envelope is manufactured using nylon PA12, and it is tightened with the motor through a custom **aluminium wedge**, designed to decrease the thermal resistance and to provide a rigid support between the frame and the vibrometer.

19 kB per acquisition

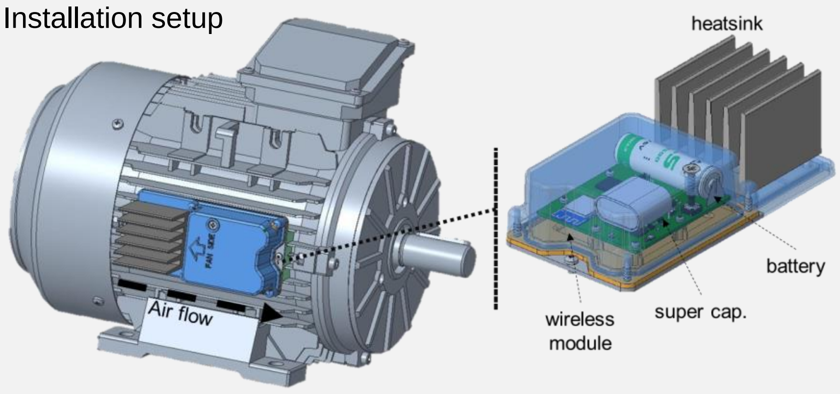
On-board processing and data compression

3.5 J total energy

Complete acquisition and transmission every **72 s**

Self-sustainability

Installation setup



Condition monitoring

A comparison between two 4 kW TA,TC motors from Simotop. One brand new and a used (> 1000 h) motor, which was returned to the supplier as malfunctioning. Both were secured to the braked dyno utilizing a torque wrench to ensure identical setups. To verify the ability to detect and predict failures, the same sensor node was installed on both devices, loaded equally at the nominal power.

5 Conclusion

This poster presents a ***deploy and forget*** sensor node for predictive maintenance. Our prototype was designed, tested, and deployed in an actual setup, where it can detect incoming failures. Thanks to its optimized TEG harvester, engineered to work on the external metallic frame, the self-sustainability is reached. This sensor node can enable future developments in **predictive maintenance** and failure detection supporting **long-term** and dense data collection campaigns on operating electric motors.