**INA - Open Source Sensor Node**

**Inexpensive Node for General Applications**

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### Configuration

- ATmega 1284P 8-bit RISC microcontroller up to 16 MHz, JTAG, SPI, I²C, 128 kB Flash, 16 kB RAM, 4 kB EEPROM, 10-bit A/D-Converter
- AT86RF321 2.4 GHz radio: IEEE 802.15.4, ZigBee, 6LoWPAN, hardware AES encryption support
- Program, debug and charge Li+-battery via USB
- 16 MBit onboard Flash and microSD-card slot
- Various sensors: online voltage and current monitoring, accelerometer, gyroscope, pressure sensor, temperature sensors, push button
- Easily expandable via buses, I/O-ports (0.1 in) pin headers
- Completely open source, cheap and hand solderable

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### Accelerometer

In previous evaluations we compared multiple types of accelerometers and for INGA the one with the lowest power consumption and the lowest bit noise was chosen. The Analog Devices ADXL345 MEMS-accelerometer can detect accelerations in 3 axis at variable bit rates and sensitivity. It can be used for fall detection or gait analysis when attached to a human body. As gravity is always detected the orientation towards the center of earth can be determined. The accelerometer is attached to INGA’s MSPI bus and has an adjustable sampling rate of up to 3.2 kHz. Its dimensions are 3 x 5 x 1 mm.

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### Gyroscope

The ST-Microelectronics L3G4200 MEMS-gyroscope is able to measure deviations of orientation and thus to determine the location more precisely. It is able to detect up to 2000 degrees per second in three axis (16 bit). The gyroscope has an integrated temperature sensor (8 bit) and is attached to INGA’s I²C bus. Its dimensions are 4 x 4 x 1 mm.

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### Pressure Sensor

The Bosch BMP085 pressure sensor can also be used for gait analysis as it is able to detect deviations in pressure in the area of 0.01 hPa. Such deviations result e.g. from a change in elevation in the magnitude of centimeters. Thus, it can be determined whether a person is going up- or down-stairs. Its dimension are 5 x 5 x 1 mm. The pressure sensor has 16 to 19 bit resolution and is equipped with an integrated temperature sensor for temperature compensation and by this way it is able to measure absolute pressure as well. It is attached to INGAs I²C bus.

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### Architecture

![Architecture Diagram](image)

- RF-Transceiver AT86RF231
- USB / UART FTDI232
- Li+ Charger MAX1555
- Li+ Battery
- Power Monitoring Voltage & Current
- MCU ATmega1284p
- User Switch
- User LEDs
- SPI
- I²C
- UART-0 Reset
- UART-0
- FSO
- Pressure Sensor BMP085
- Gyroscope L3G4200D
- Micro SD-Card
- Accelerometer ADXL345
- Flash Memory AT45DBxx1
- MSPI CS
- UART-0 JTAG
- I²C
- MSPI
- SPI
- I/O
- ADC
- GPIO

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### Resources

INGA is completely Open Source, check it out at:

http://www.ibr.cs.tu-bs.de/projects/inga