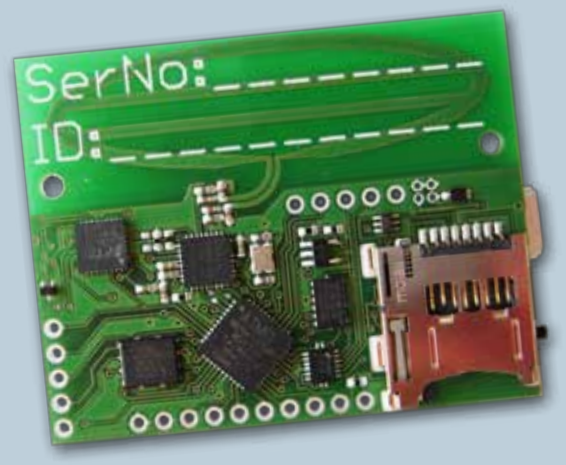

↑ Backside view of INGA. Note that the original size (50 x 39 x 7 mm³) is much smaller than this image.

Ease of Use

INGA can easily be **programmed over USB** using the AVR-DUDE compatible stock bootloader. **Linux**, **Mac OS X** and **Windows** host operating systems are supported by INGA's **open source toolchain** for development and flashing.

A port for the open source operating system **Contiki** with **full hardware support** is present in INGA's GIT repository. **TinyOS** is also supported in its basic functionality. The huge existing AVR community can help to get started and provides an easy entry to the programming an extension of INGA.

With its **2.54 mm pin headers**, INGA can easily be interfaced to breadboards or self-developed extensions. **JTAG** pin headers for debugging or recovery flashing are present on 2.54 mm pin headers as well. ISP is available on emergency pads. **Exchangeable memory cards** support the deployment of configurations, firmware updates and allow PC compatible storage of measurement data.

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INGA is open source, check it out at:
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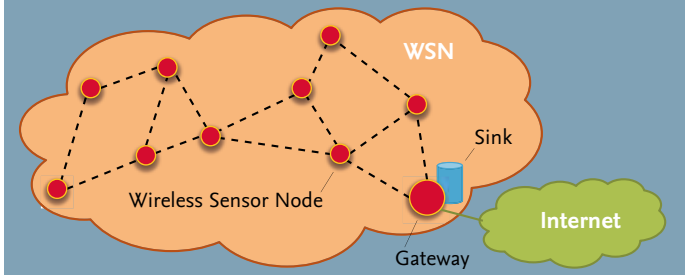
INGA

An Inexpensive Node for General Applications

Wireless Sensor Networks

Fields of application for Wireless Sensor Networks (WSN) are various and ubiquitous. In general, any data can be recorded, processed and transmitted wirelessly, probably to a sink.
A Wireless Sensor Network consists of many Wireless Sensor Nodes, which are actually very small computers, mostly battery powered. Due to energy constraints, these nodes are usually equipped with very small and energy efficient microcontrollers and miscellaneous sensors to gather divers data.



INGA

INGA is a cost-efficient and universal Wireless Sensor Node for activity monitoring and for various other applications. The motivation to develop INGA was driven by the need for a reasonable, cheap and expandable node for several use cases. The set of sensors present on INGA, allows for movement and activity detection: Accelerometer and Gyroscope can detect six degrees of freedom; additional sensors for temperature and barometric pressure provide supplementary information. A Micro SD-card compatible slot gives the opportunity to easily extend the 16 Mbit of onboard memory. All relevant connections can be accessed through 2.54 mm pin headers. INGA's Hardware is open source and already provides full support for the open source Contiki OS.

Hardware Facts

MCU: Atmel ATmega 1284p

- 8-bit pico-power RISC-MCU, @ up to 14 MHz
- 128 kB Flash, 16 kB RAM, 4 kB EEPROM, 10-bit-ADC

Radio: Atmel AT86RF231

- 2.4 GHz IEEE802.15.4, ZigBee, 6LoWPAN Radio Transceiver
- Hardware AES support
- PCB High Gain-Antenna

Communication

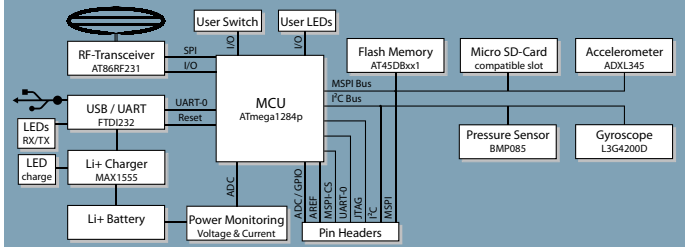
- Connection to PC via FTDI USB UART
- Multiplexed 2nd SPI, I²C, JTAG, UART, digital or analog I/O
- 2 user LEDs, user push-button, on/off-switch

Onboard Sensors

- 3-axis digital accelerometer (Analog Devices ADXL345)
- 3-axis digital gyroscope (ST Microelectronics L3G4200D)
- Digital pressure sensor (Bosch BMP085)
- Digital temperature sensors (in BMP085 and L3G4200D)
- Online current and voltage sensing

Storage

- Atmel AT45DB161D 16 MBit dual buffer Flash Memory
- Micro SD-Card compatible slot



↑ Architecture diagram: All busses are present on 2.54 mm pin headers. The Micro SD-Card compatible slot can be switched completely powerless.

Features

With 50 x 39 x 7 mm³ INGA is relatively small and combines the advantages of other wireless sensor nodes. It is designed to be "lead-free" and for capacitors no rare materials (like tantalum) are needed. INGA was designed to be built in a cost-efficient way, thus, it consists of a two-layer PCB (with a printed antenna) which can be self manufactured and soldered by (skilled) hand. It can be powered via USB and charge attached LiPo-Batteries.

Open Source

INGA is open source hardware. Board layouts and customizable schematics are available through INGA's website and can be adapted for individual developments. An open source toolchain and a community for open source hardware extensions helps for the start of own projects.
Several code examples, designs for hardware extensions and a Wiki with additional information are available via INGA's website.

Exemplary Applications

INGA's set of sensors is capable of monitoring movement, position and activity, which is very useful for medical applications. It is e.g. very suitable for gait analysis, activity monitoring or fall detection. The same set of sensors can also be used in flight navigation (for example "quadrocopters") with the additional benefit of a wireless remote control.
Nevertheless, as INGA is easy to expand and other sensors are easily attachable, INGA is also useful for many other applications and research in the area of wireless sensor networks in general. Projects like the following have already been implemented using INGA:

- Integration of a display and a GPS receiver
- Wii-like game controller with 8 button I/O expansion
- Intelligent and easy to set up home automation system
- Cyclometer with integrated weather station
- Distributed Blinkenlights and RGB-LED expansion