

# Programming Embedded Systems 2015/ JB

**Exercise 5** / 23/27.2.2015 / Deadline for submitting report 13.3.2015

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This time we will work on an alternative embedded system, and an alternative way to program. The programming this time is similar to the Arduino project. The hardware is:

- 1) Texas Instruments TivaC development card + homebrew daughtercard.

## **TivaC + daughtercard**

The TI TivaC can be programmed by standard TI tools, but here we instead use the port of the Arduino-based developing environment for TI. This is called Energia, and is found on the web-site **energia.nu**.

The daughterboard has the following components: pushbuttons, leds, NTC-resistor and and 3-axis accelerometer. In this exercise, we will use the accelerometer.

## **Task**

- Construct software for reading the accelerometer. In **normal conditions** (acceleration 9,81 m/s<sup>2</sup>), **green led** is lit. In **high acceleration** (> 12 m/s<sup>2</sup>) also the **yellow led** is lighted. In even higher, also the red led is on.

The accelerometer measures acceleration in 3 axis (x,y,z), and is read using the ADC, using pins (A9, A8, A10). The leds (green, yellow, red) are accessed through the pins (PB2, PE0, PB7). The accelerometer measures the the force affecting a mass ( $F=ma$ ), so that if the force is 0, the analog output is half of the input voltage to the sensor. The total acceleration vector affecting the mass is hence given by  $k \cdot \sqrt{(x-x_0)^2 + (y-y_0)^2 + (z-z_0)^2}$ , where k is a gain constant and (x<sub>0</sub>, y<sub>0</sub>, z<sub>0</sub>) describes the value of respective axes when no force is on the mass in that direction. Hence, you must try to make estimates of k, x<sub>0</sub>, y<sub>0</sub> and z<sub>0</sub>. This can be done by using the debug port to output readings from the force measurements

The Energia software is using to basic software function: `setup()` where all setup should be made and `loop()` which is called iteratively. No `main()` function is provided in this system by the programmer, but that is included in the Energia-environment. Debug information is easy to output using the inbuilt serial port over USB.