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Water Simulation with Particle Method, RGB LED-Matrix-Panels and Accelerometer

ARM Project Presentation

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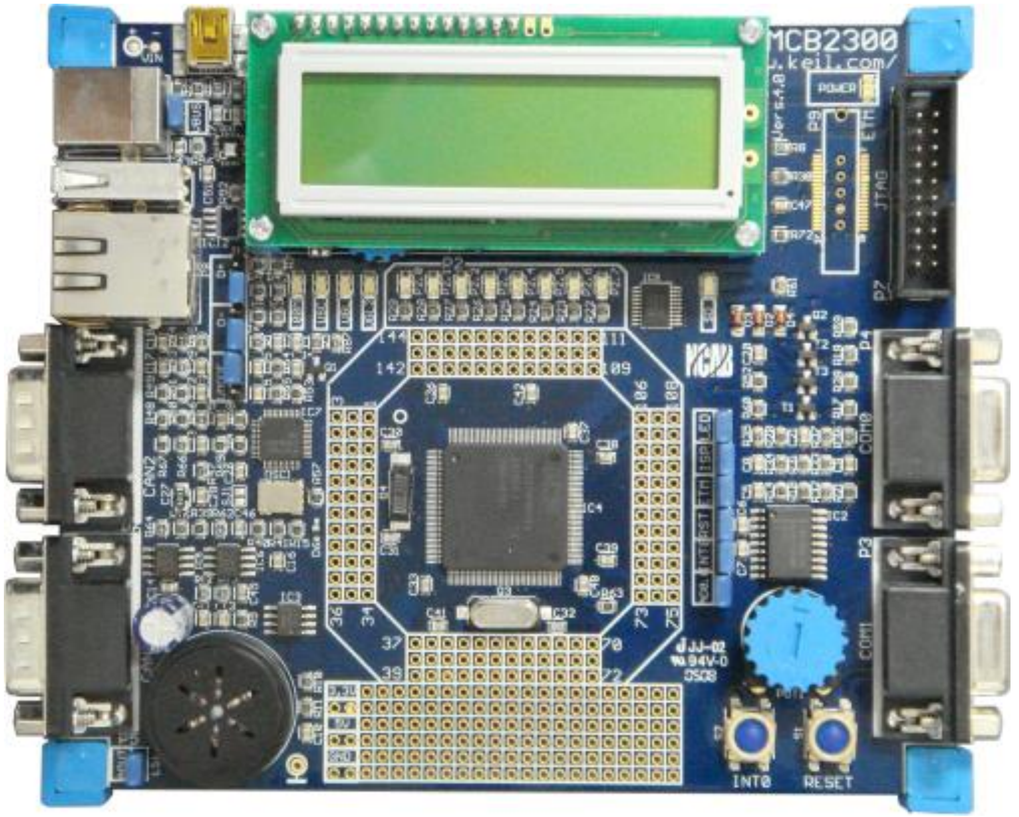
ADVANCED ARM PROGRAMMING

Based on Keil MCB2300 Board

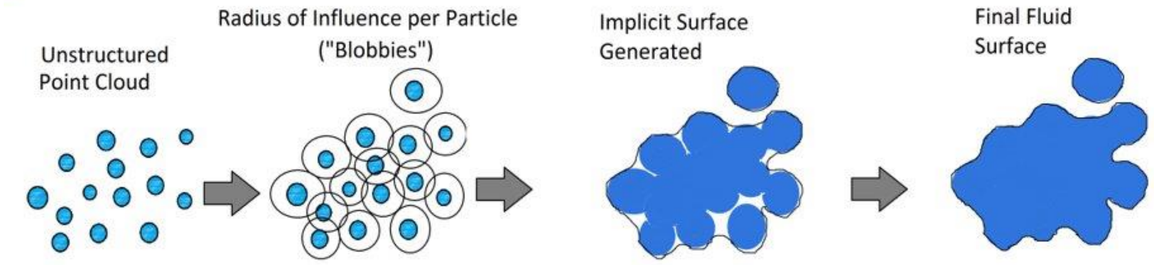
LPC2300 ARM family and allows us to create and test working programs for this advanced architecture.

Two serial interfaces, a speaker, analog input (via potentiometer), two CAN interfaces, LCD, USB, Ethernet, and eight LEDs make this board a great starting point for our next ARM project.



What is behind the water simulation?

- Two basic principles: Grid based calculation or particle based calculation
- Particle based faster but less precise



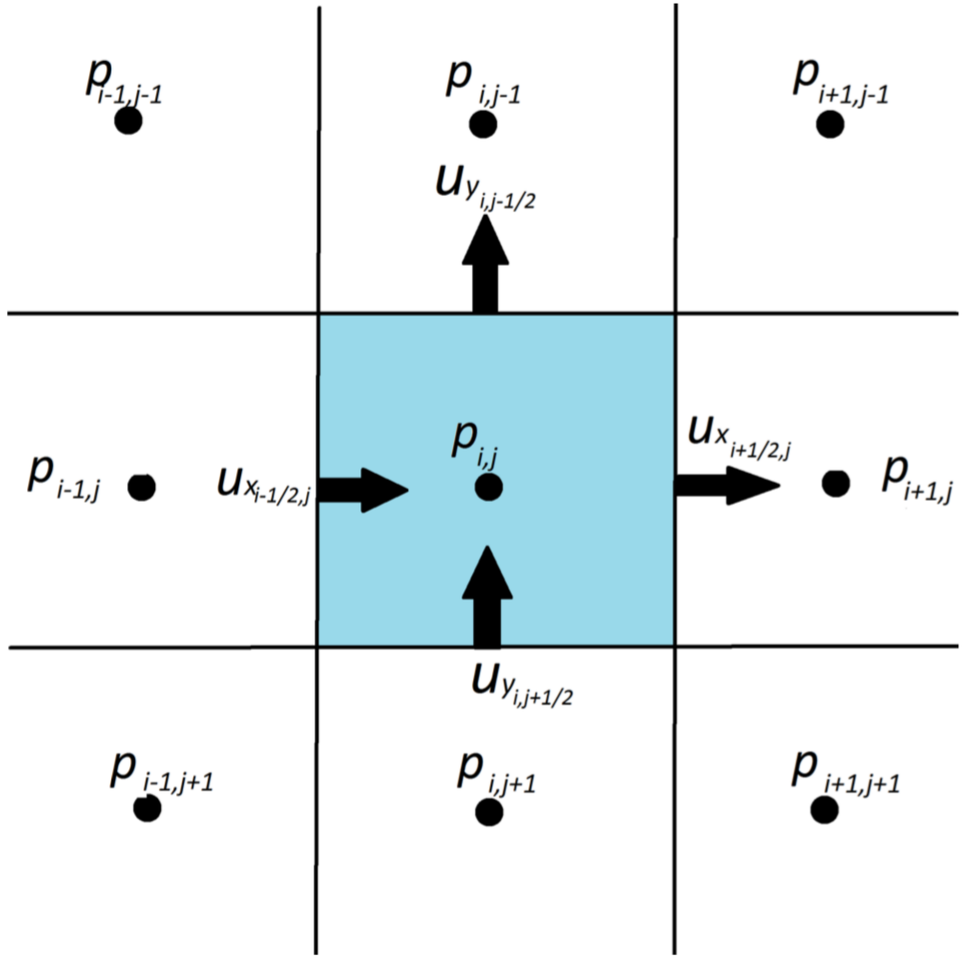


Bild: Fluid Simulation For Computer Graphics: A Tutorial in Grid Based and Particle Based Methods

Particle Based Method

- Particle based simulation with the incompressible Navier Stokes equations
- Kernel: poly6, spikey, viscosity
- Speedup via grid-structure

1. Calculate all Forces on particle
2. Integrate forces for acceleration
3. Calculate movement

Calculation speed-up via RP 1B

- Problem: Clock of MCB2388 too slow (72MHz) for simulation and smooth display
- Solution: Move simulation to external device: Raspberry Pi 1B (700MHz)
    - Bare-Metal programming on RP
    - UART communication between RP and MCB

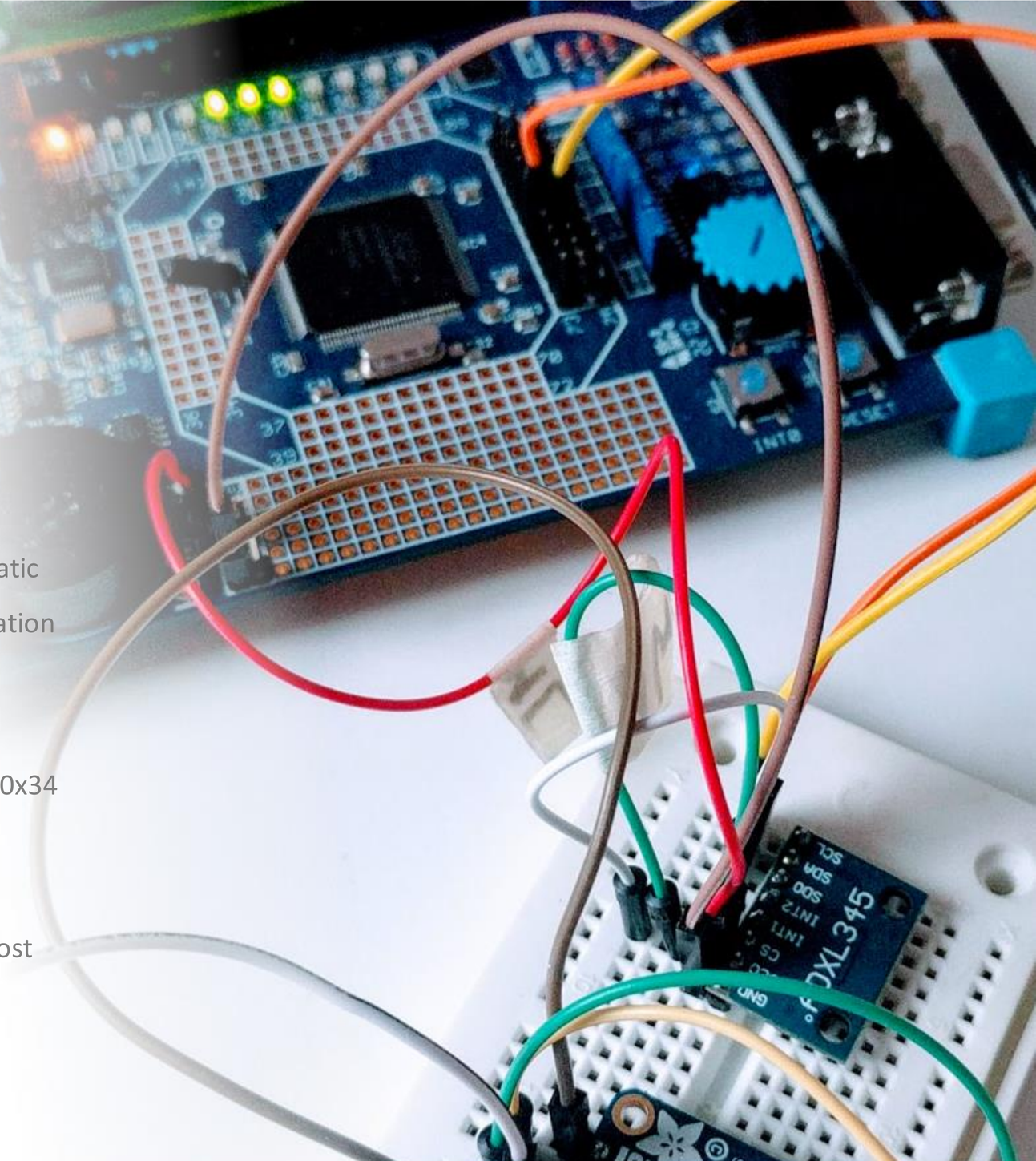
ADVANCED ARM PROGRAMMING

WINTERSEMESTER 2018/2019

3-Axis Digital Accelerometer

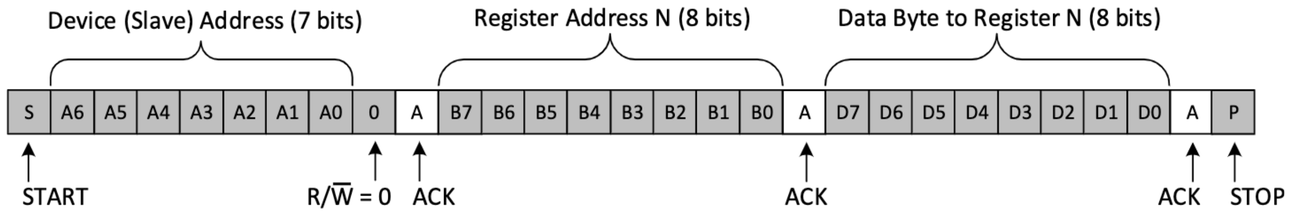
The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock.

Register 0x32 and Register 0x33 hold the output data for the x-axis, Register 0x34 and Register 0x35 hold the output data for the y-axis, and Register 0x36 and Register 0x37 hold the output data for the z-axis. The output data is twos complement, with DATAx0 as the least significant byte and DATAx1 as the most significant byte, where x represent X, Y, or Z.



I2C digital interface

Write to One Register in a Device



I2C only uses two wires to transmit data between devices:

SDA (Serial Data) – The line for the master and slave to send and receive data.

SCL (Serial Clock) – The line that carries the clock signal.

Read From One Register in a Device

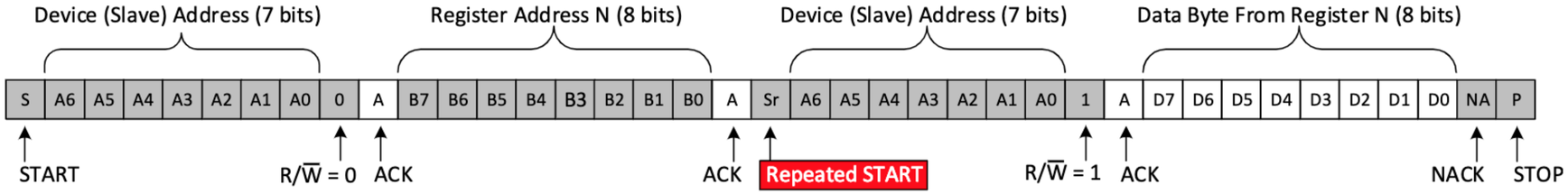
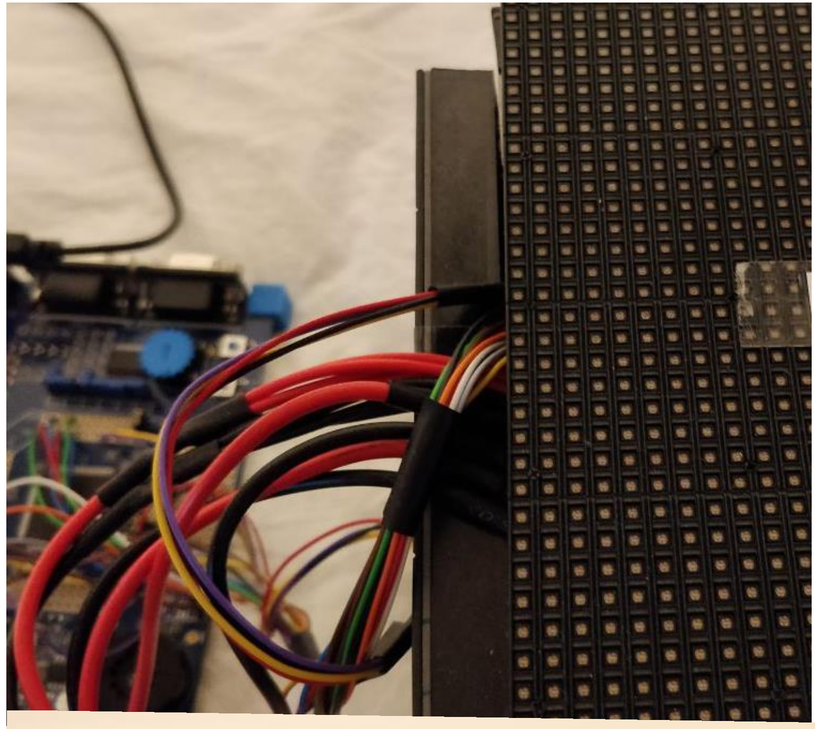
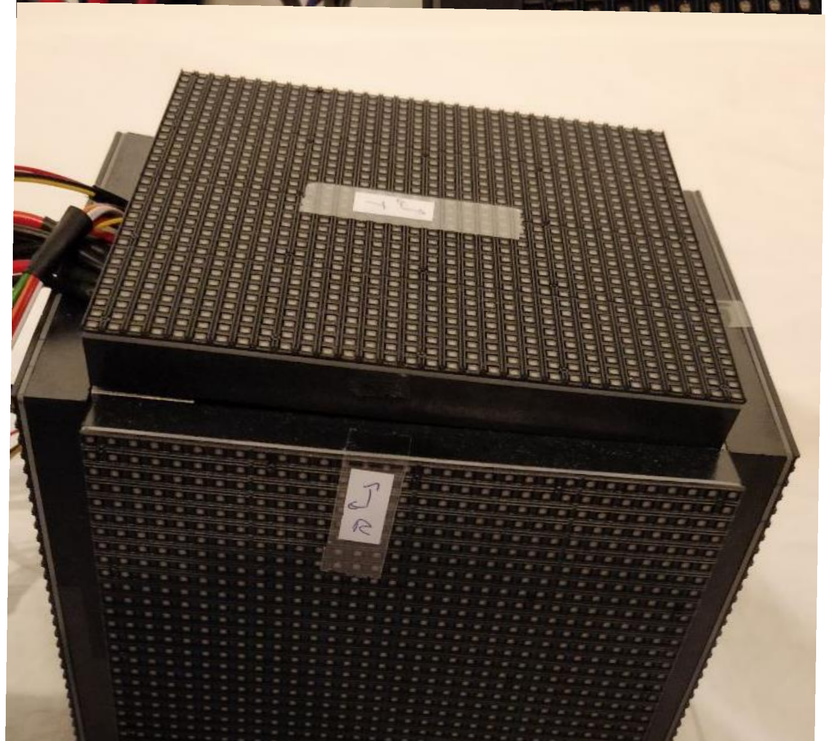


Bild: Texas Instruments. Understanding I2C. http://www.ti.com/lit/an/slva704/slva704.pdf

32x32 RGB LED-Matrix-Panels

- 6x 32x32 RGB LED-Matrix-Panels for cube
- Signals
  * RGB signals for upper and lower half rows
  * Address ABCD for row selection
  * CLK, LAT, OE
- 32-bit shift register
- No PWM module
- Daisy-chainable





LED-Matrix-Panels: Programming

Load color information into shift register

1. Set all pins low
2. Set RGB pins
3. Set clock high/low

Select row address

4. Set ABCD

Control signal

5. Set OE high
6. Set LAT high (LEDs are lit)
7. Set LAT low
8. Set OE low

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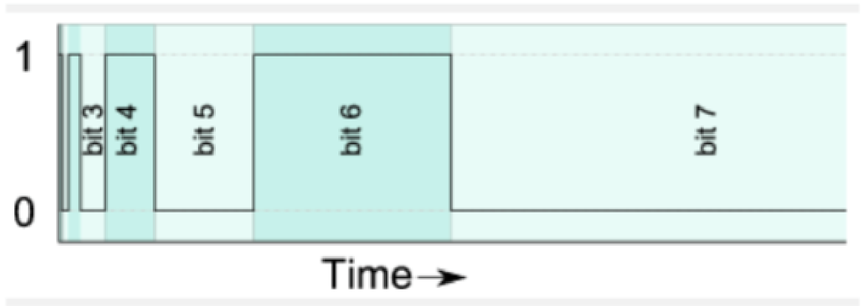
Demonstration of color intensity by use of Binary Coded Manipulation instead of PWM module



85/255th duty cycle

Source: http://www.batsocks.co.uk/readme/art_bcm_3.htm

Assembled Cube for water simulation

- 6 LED-Panels connected by angled brackets in the corners
- Accelerometer screwed to top
- Custom cabling to MCB2388, chaining of panel-IOs