Using sensor data to generate random bit-strings

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General

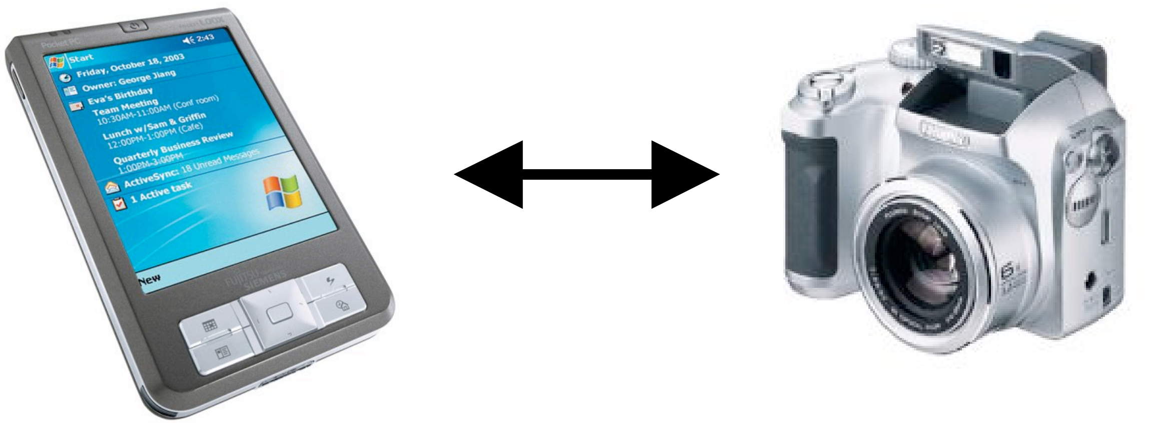
- Generate random bit-strings from sensor data for use in cryptographic applications.

- If we could generate the identical sequence in two places at the same time we would solve the key distribution problem.

Applications

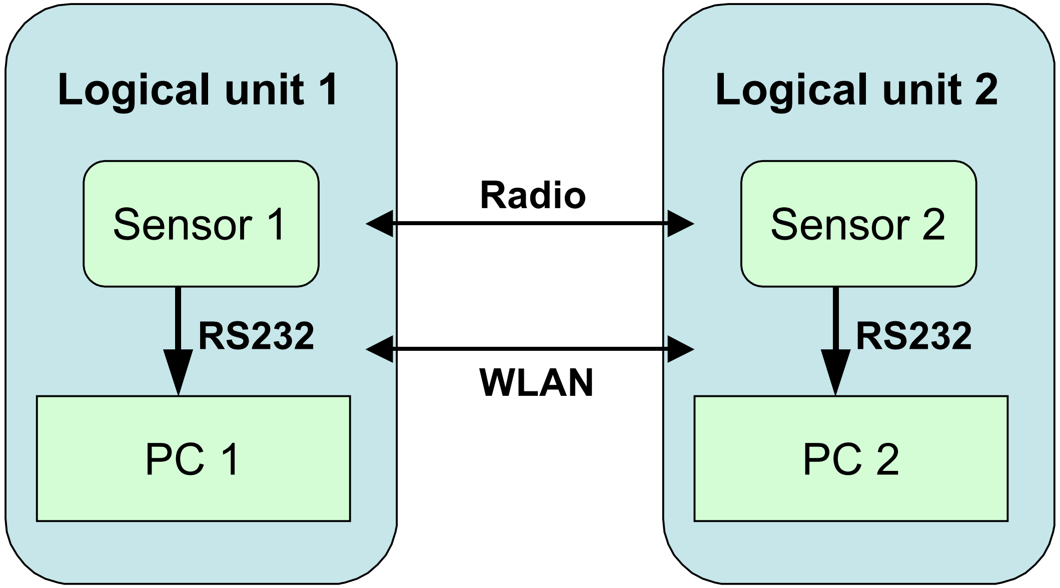
- Applicable only locally, not for encrypting traffic over the Internet.

- For example, between PDA’s, mobile phones and digital cameras.



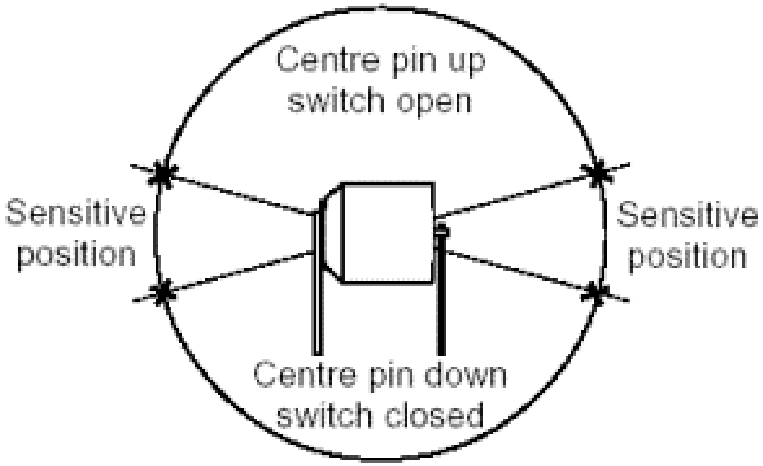
Set-up

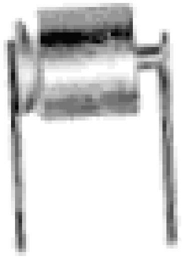
- Embedded Sensor Board (ESB)
  - – Contiki Operating System
- PC



Tilt sensor

- How does it work?
- How does contiki handle the sensor?





Sub goals

- Compile applications for Contiki.
- Send sensor data from ESB to PC.
- Process sensor data on PC side.
- Shake two sensors simultaneous and see if the same bit-string is created.

Solutions / ESB

- Poll sensor every 500/1000ms

- The difference between two consecutive polls is sent to the PC via RS232 (serial port).

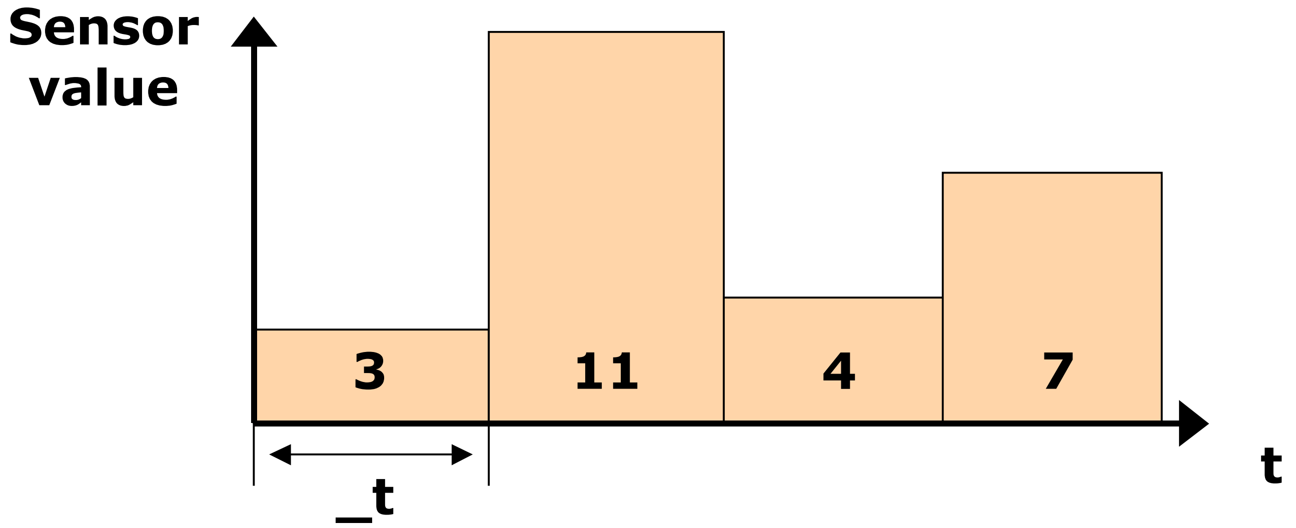
Solutions / PC

- Read sensor data from RS232 and present incoming values in a histogram in real-time.
- Extract bits and construct the bit-string.
- Perform randomness tests on the bit-string.

Solutions / bit-string

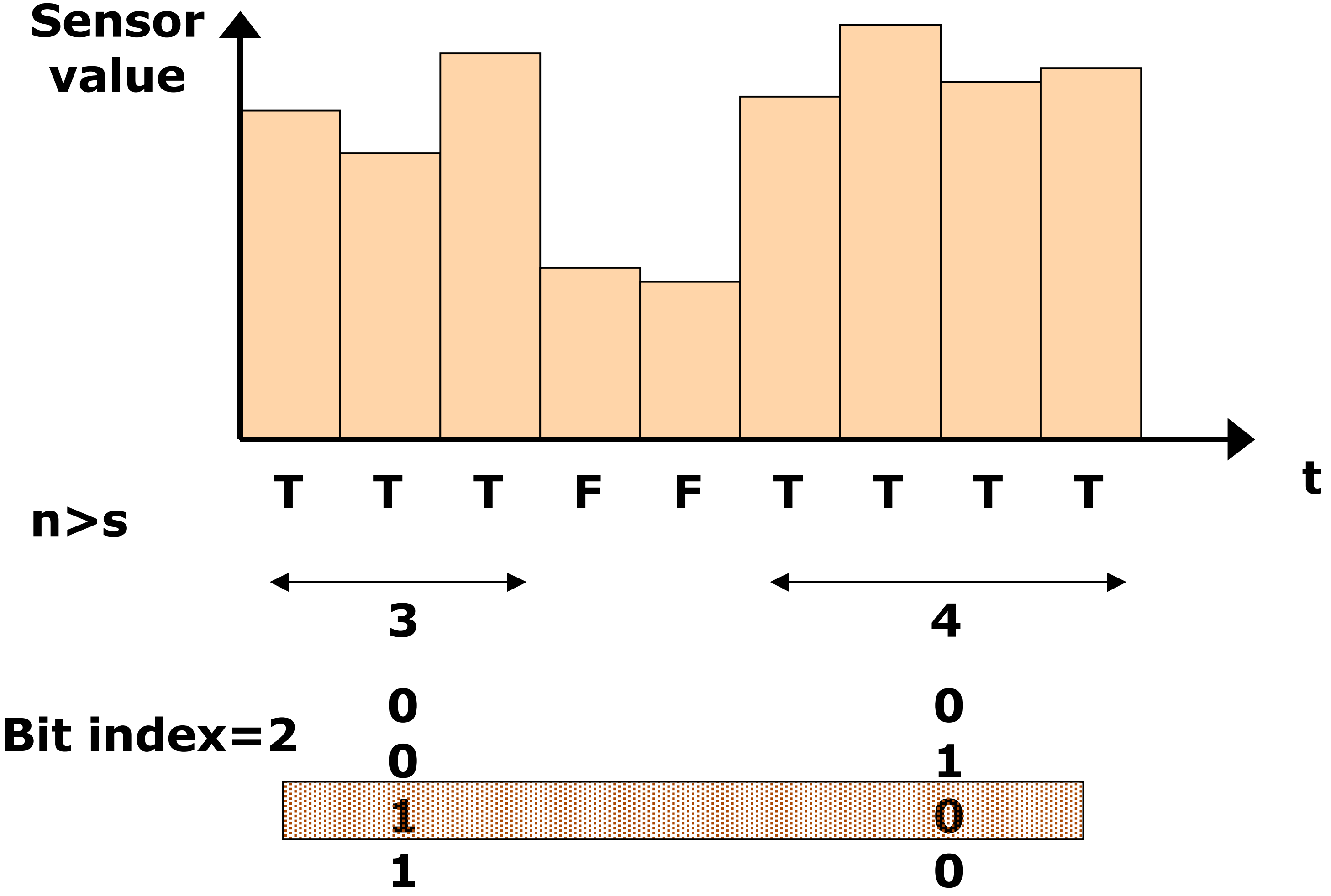
- Two approaches to generate a bit-string from sensor data
  - Sensor values from fixed intervals
  - Count consecutive intervals satisfying some condition

Sensor values from fixed intervals



	0	1	0	0
	0	0	1	1
Bit index=2	1	1	0	1
	1	1	0	1

Count consecutive intervals



n>s T T T F F T T T T

3 4

Bit index=2

0 0

0 1

1 0

1 0

Randomness tests

- Frequency test
  - Compares the number of 0’s and 1’s.
- Serial test
  - Compares overlapping occurences of 00, 01, 10, 11.
- Poker test
  - Compares non-overlapping occurences of different bit sequences of given length.

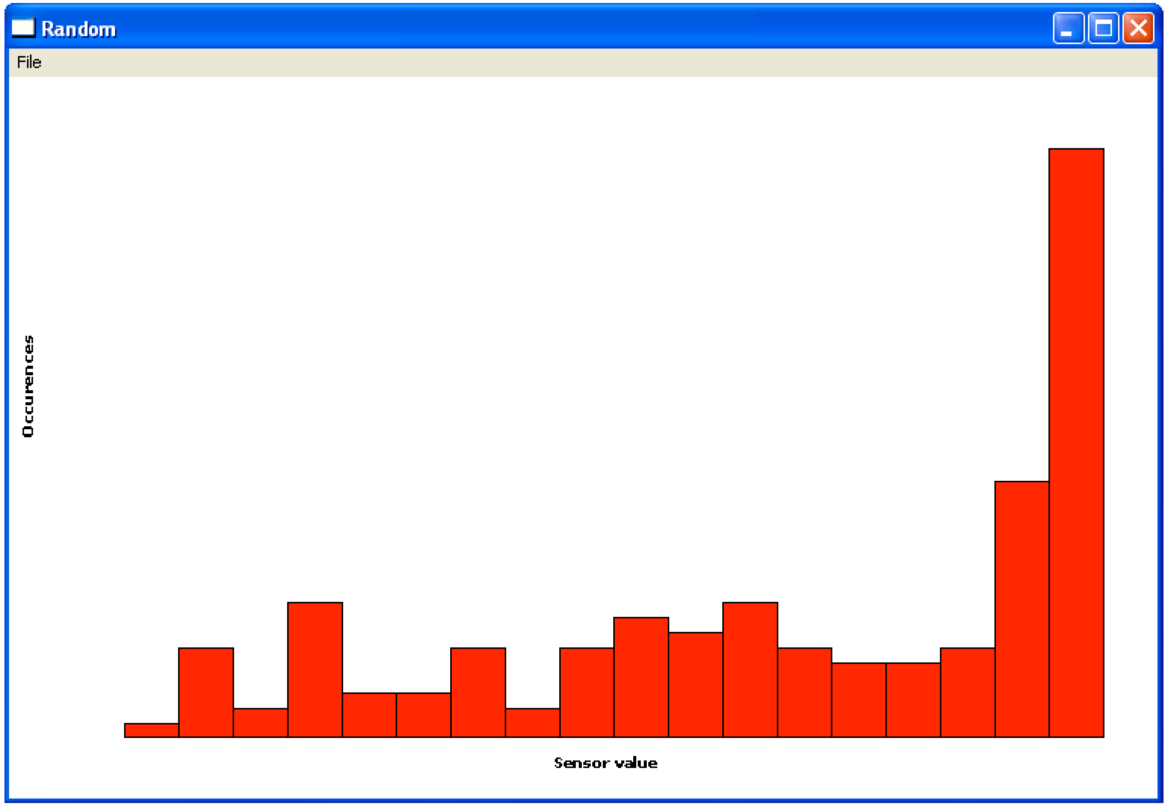
Conclusions

- The precision of the sensor was not adequate, i.e. the values differ.
- It would be preferable to use sensors with higher resolution.
- Trade-offs
  - Speed vs randomness

Conlusion cont.

- However if we had higher precision and better resolution it could probably be done.

Demo


Random
File
Occurences
Sensor value