



Technical University of Lodz



Department
of Microelectronics
and Computer Science

Patient Activity Monitor for Holter Examination

Analog Design Contest 2011

Andrzej Zamojski

Rafał Pierzyński

Supervisor: Kamil Grabowski, PhD

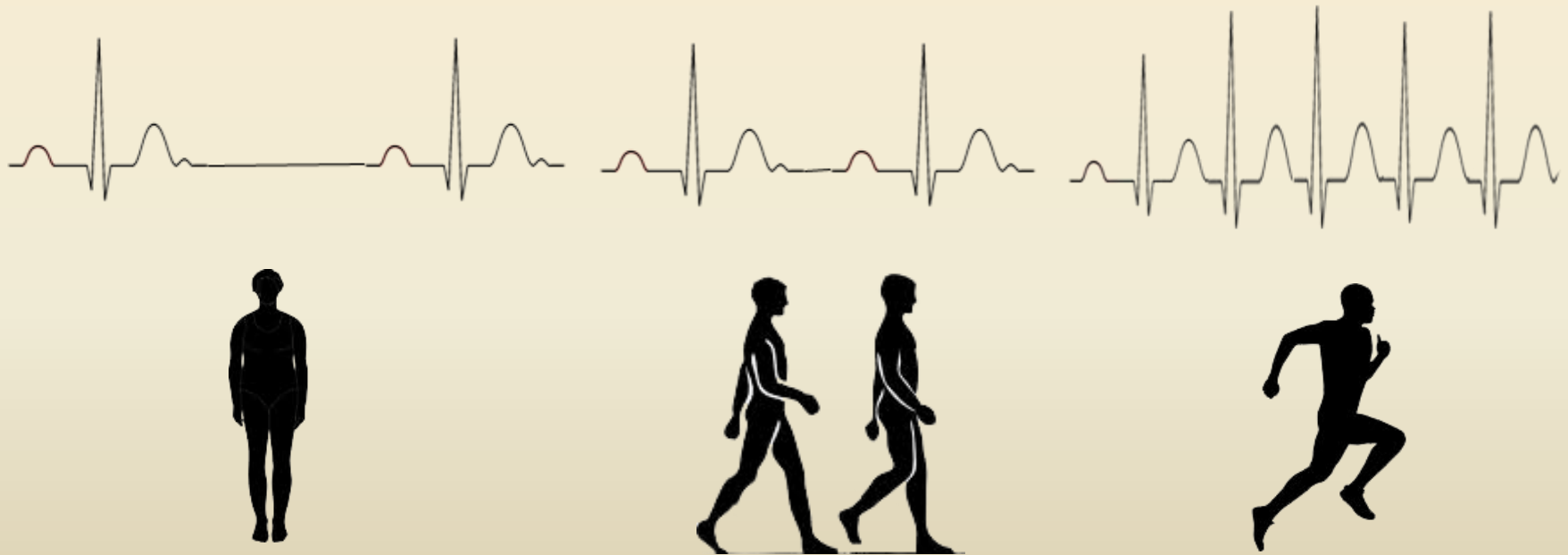
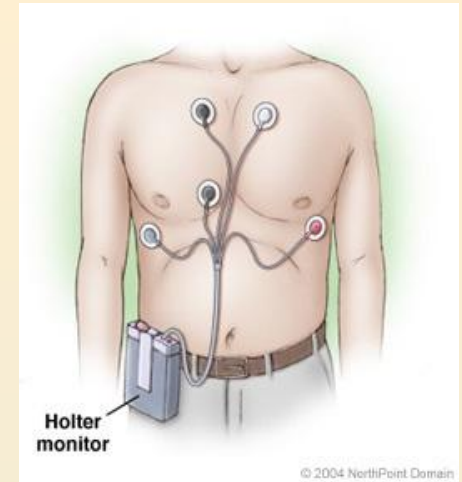
Plan of Presentation

1. Introduction – Holter Examination
2. What we are facing with?
3. Digital vs analog approach
4. System design
 - a) Charge pump
 - b) Window comparator
5. Project results
6. Final results and conclusions
7. Future plans
8. Demonstration



Introduction - Holter Examination

- a) Associate patient physical effort with recording ECG signals
- b) Increase the effectiveness of medical diagnosis



What we are facing with?

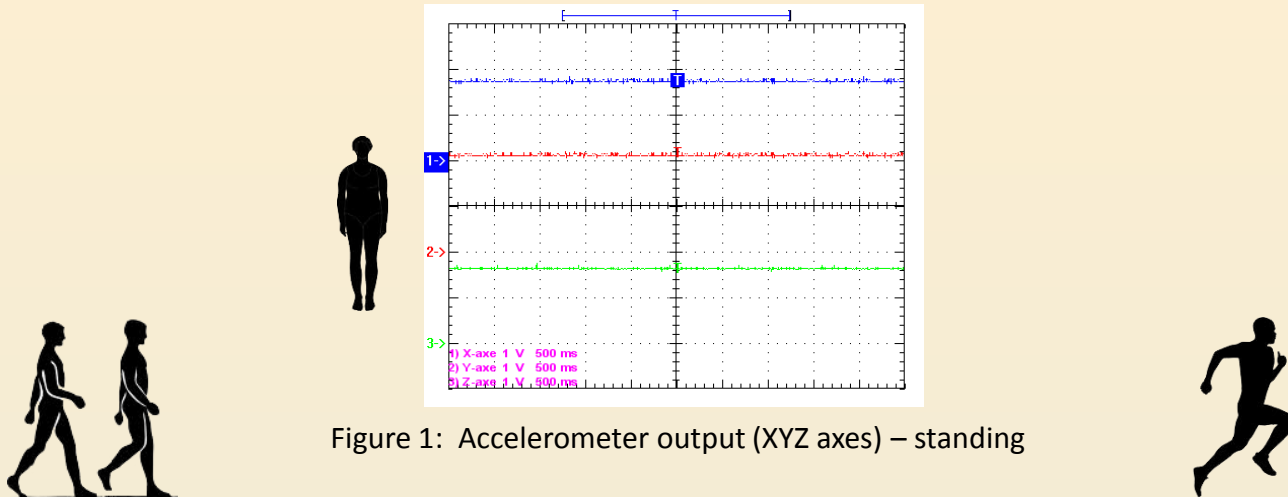


Figure 1: Accelerometer output (XYZ axes) – standing

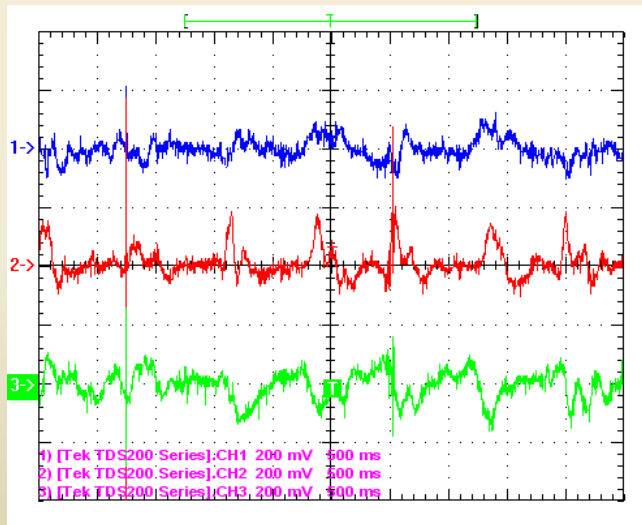


Figure 2: Accelerometer output (XYZ axes, AC) – walking

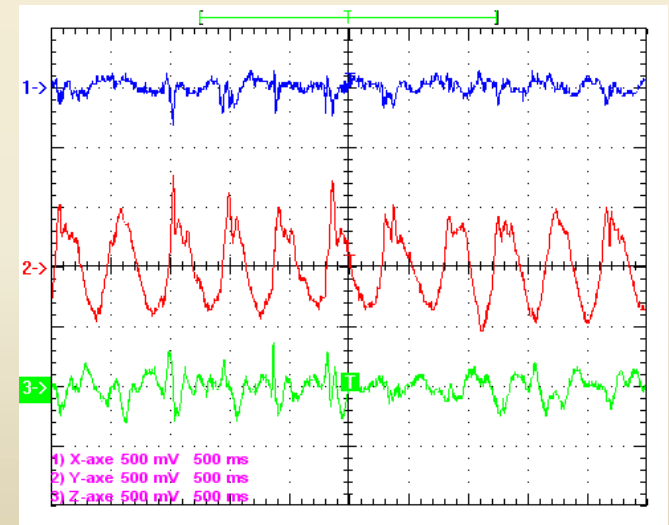


Figure 3: Accelerometer output (XYZ axes, AC) – running

Digital vs Analog Approach

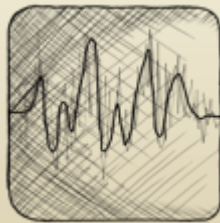
Analog

- At first sight more complicated
- Unusual approach
- Lower power consumption
- Can be integrated in one IC
- Cheaper

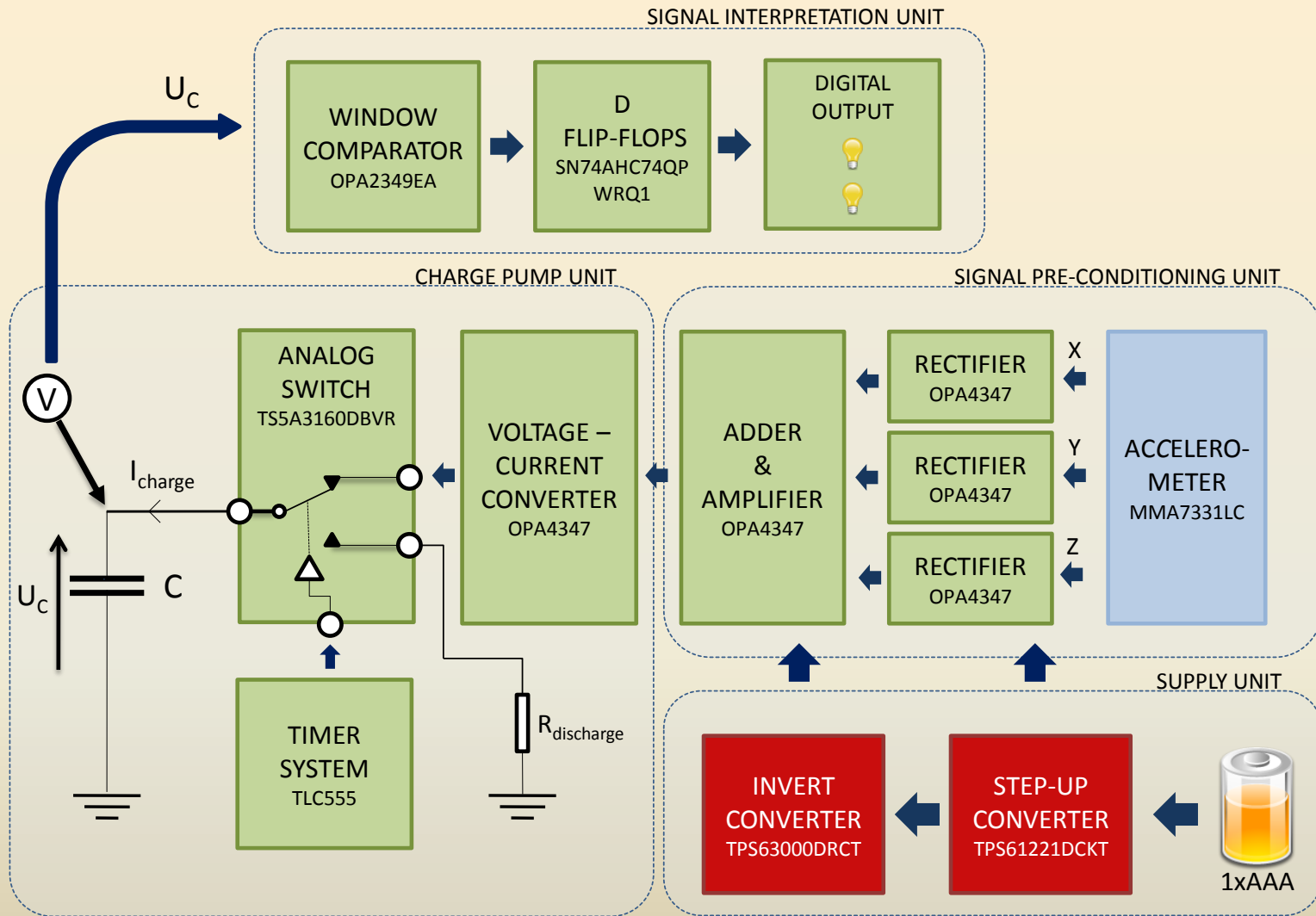


Digital

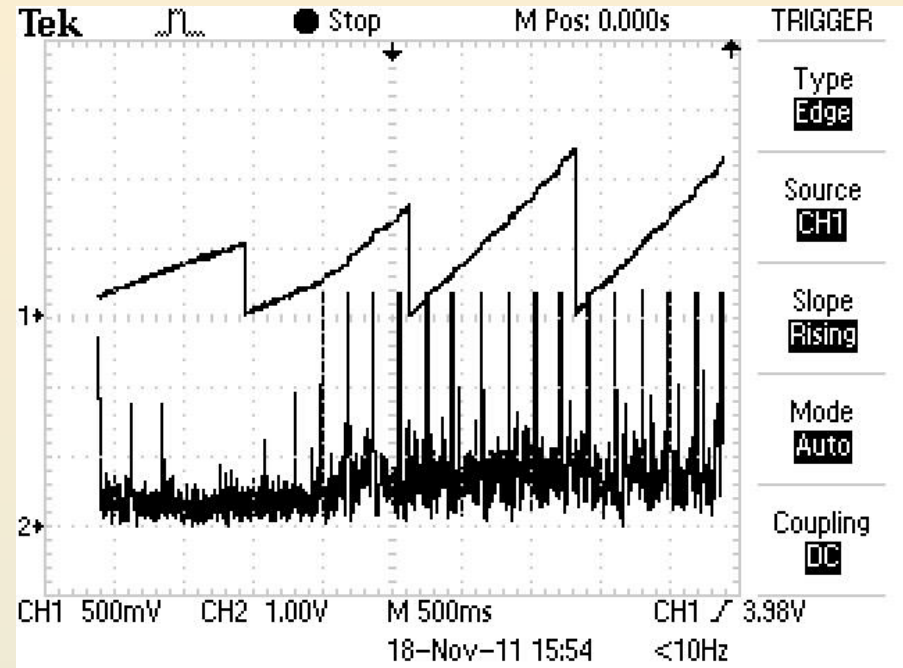
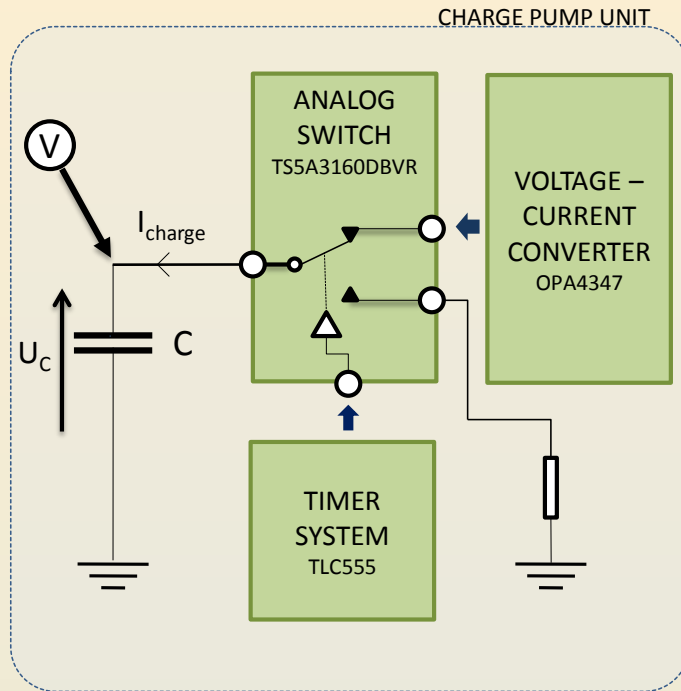
- Computationally complex (FFT)
- Higher power consumption
- More expensive
- Possibility of communication and data processing in a computer



System Design



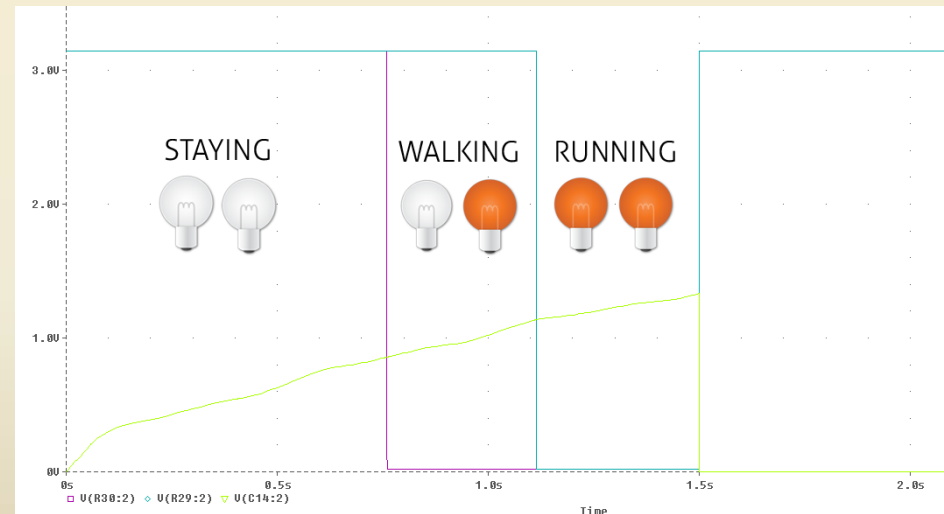
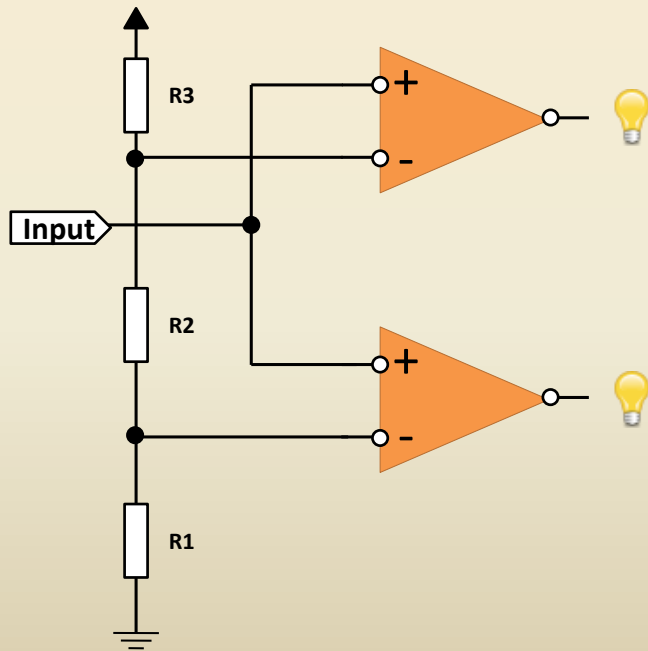
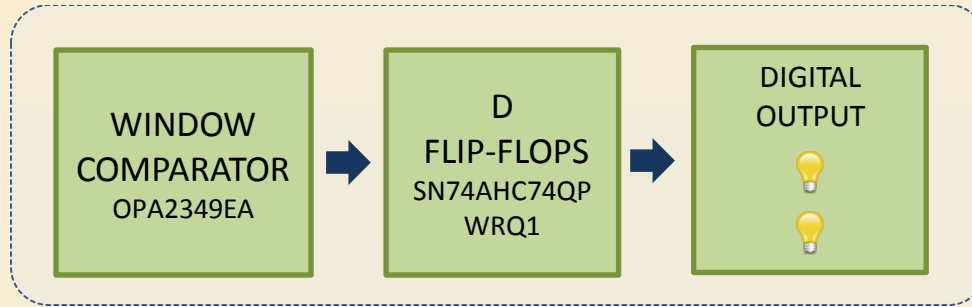
Charge Pump



$$U_c = \frac{1}{C} \int_0^t I_{charge}(\tau) d\tau$$

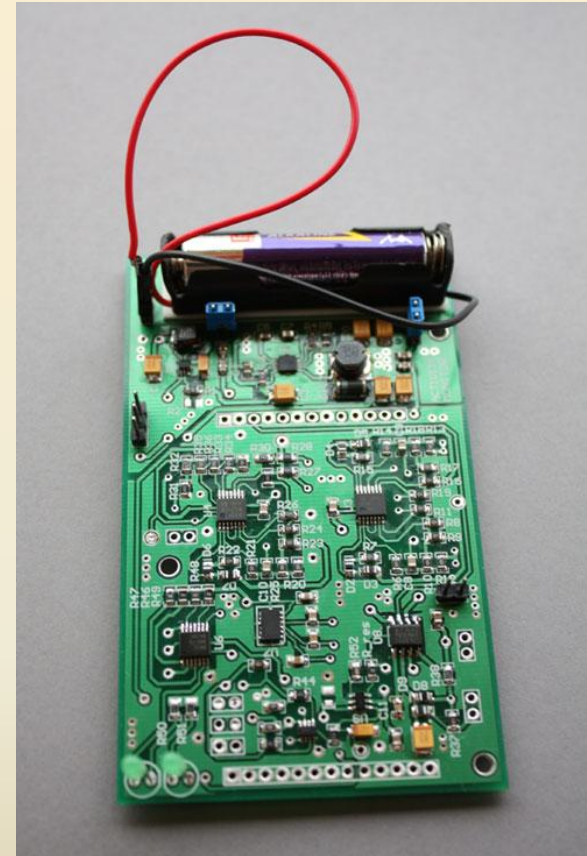


Window Comparator



Final Results & Conclusions

- Pure analog device to detect human activity
- Results independent of device position (3-axis accelerometer)
- Digital output – compatibility with microprocessor systems
- Low power consumption (40 mA at 1.5 V)



Future Plans

- Use simple microprocessor system and non-volatile memory (e.g. SD, EEPROM) to store data about activity
- Minimization of PCB size
- Pure analog system – realize as an Integrated Circuit
- Additional analog circuit to detect body position





Thank you very much
for your attention!

Do you have any
questions?