Self-Adaptive System for Medical Application

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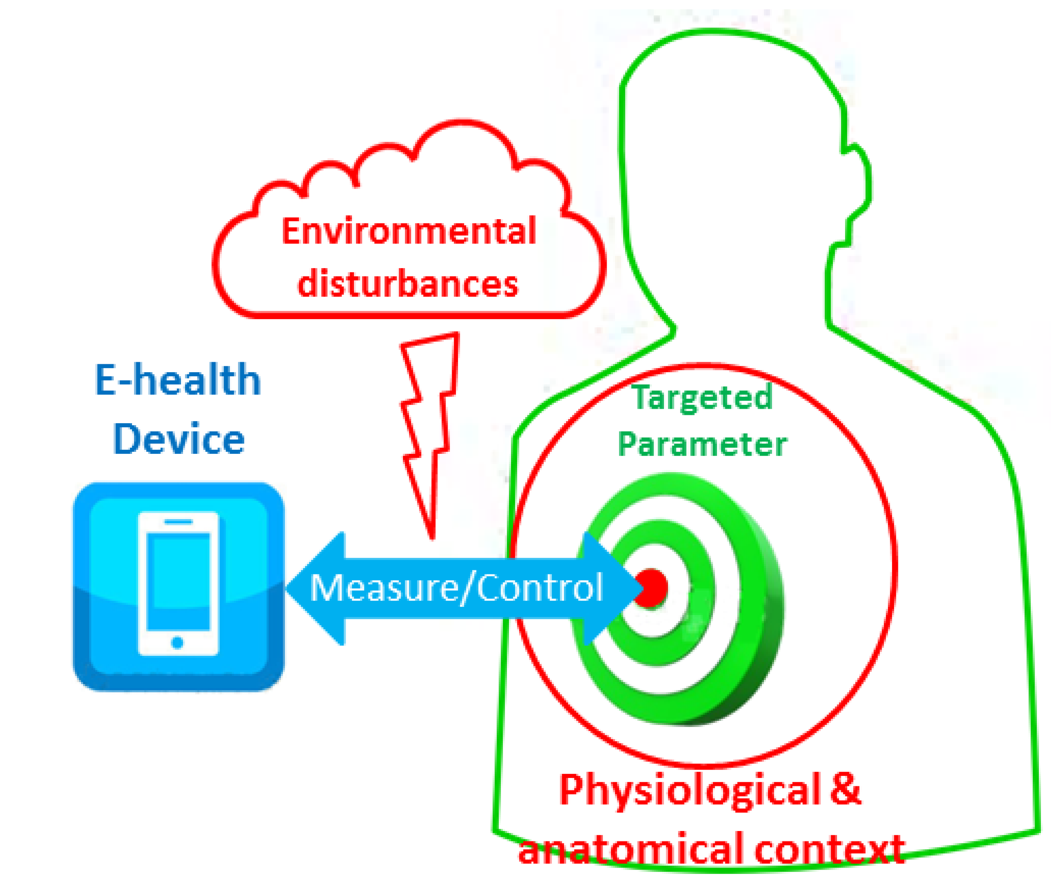
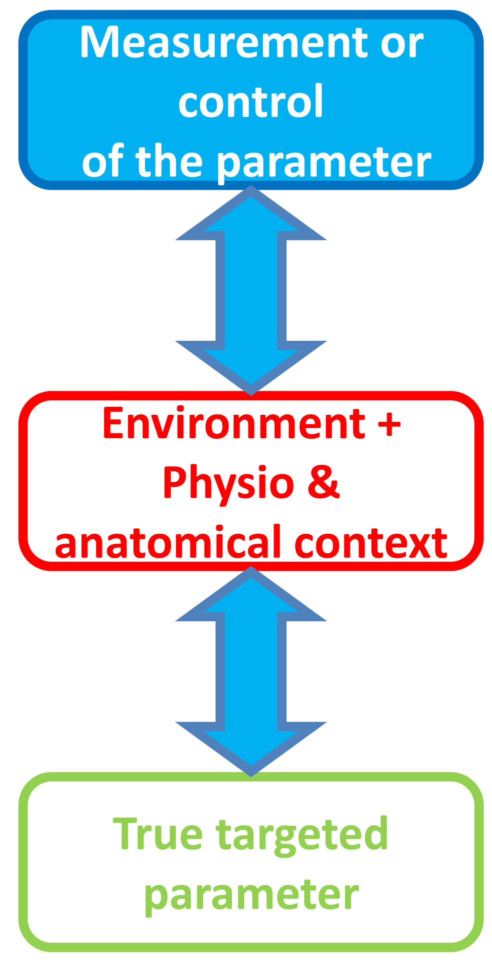
2- Ophtimalia

E-health device: the need for self-adaptation

E-health device aims at measuring or controlling a parameter → Depends on environment + physiological & anatomical context



- 2 kinds of self-adaptation are mandatory to ensure reliability
  - **At application level:** the target is the patient. Knowing demographic, systemic and specific aspect, the system must work correctly and safely taking into account:
    - The anatomy aspect associated with the targeted parameter
    - The physiology aspect associated with the targeted parameter
  - **At environment level**: In addition of the surrounding environment (Electromagnetic fields, temperature,...) that can disturb the system, the patient becomes the environment and may interfere directly or indirectly on the system operation.

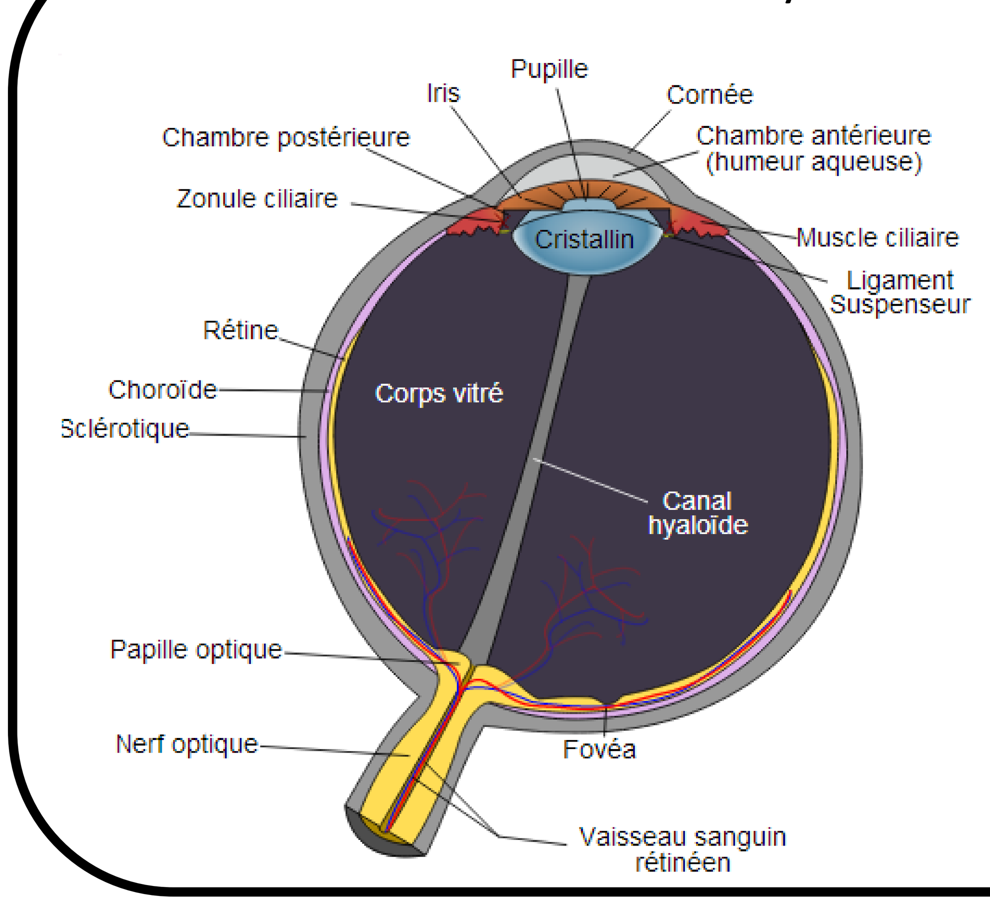


Successive steps for developing the self-adaptation solution for electronic devices

1. Indentify the direct or indirect indicators correlated with the targeted parameter
2. Develop the measurement scheme to extract these parameters
3. Identify nodes and associated actions available to tune the system
4. Develop the control scheme to adapt the system

Case study: glaucoma diagnosis and monitoring

Cross section view of the eye



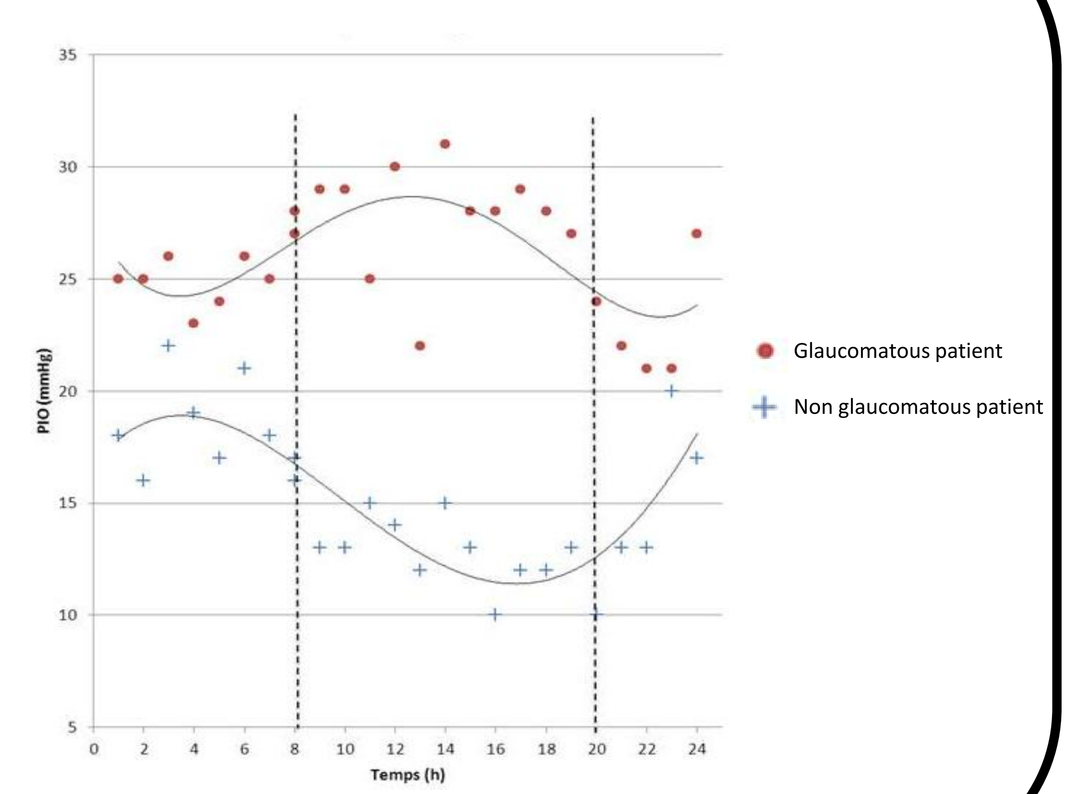
The disease: Deterioration of the optic nerve associated (most of the time) with an high intra-ocular pressure (IOP).

Magnitude: Affected by more than 60 million people over the world this lead to a partial or total permanent .

Detecting method: Applanation tonometry perform a punctual measure of IOP by flattening a constant cornea's area by a force depending on the IOP.

Problem: IOP is fluctuating during the day and the night => not reliable diagnostic. It's implies light error because of the cornea thickness variability, corrected with a thickness measurement.

24 hours IOP of non glaucomatous and glaucomatous patients [1]



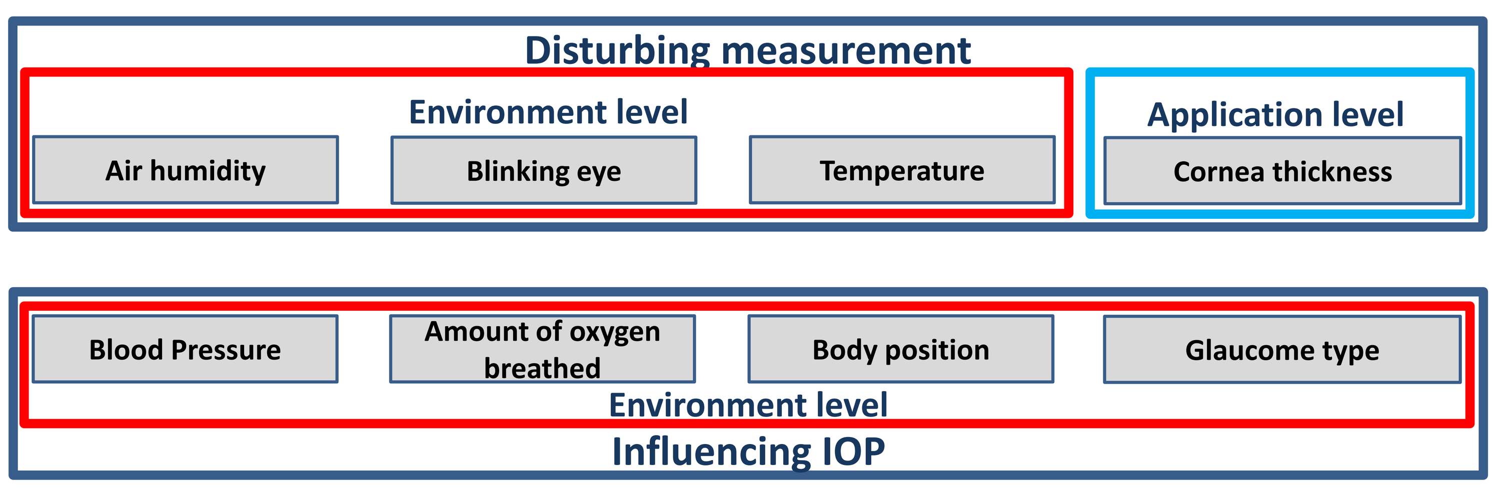
Solution: Monitoring the IOP during 24 hours.
Need: Self-adaption to the patient and its environment: avoid any discomfort, disturbances from patient activity, physiological, anatomical and environmental parameters that distort the monitoring during 24 hours.

Identification of the most significant indicators for IOP measurement

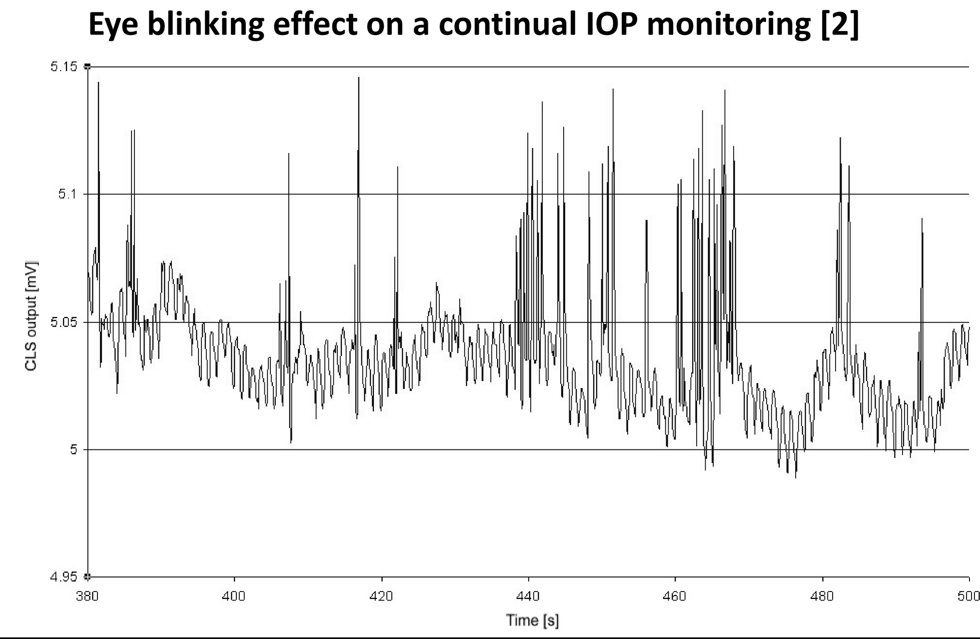
Parameters which play role can be divided in two different groups in which there is environmental and physiological parameters:

- Those which are correlated to the IOP or IOP's variations. They give direct or indirect information on the IOP level or evolution and help to validate the monitoring.
- The parameters which disturb the measure. They can be used to correct the monitoring of the IOP.

However there is too many parameters and a choice must be made in function of the significant parameter. Moreover some parameter are point of interest in the context of general research for Glaucoma.



Eye blinking effect on a continual IOP monitoring [2]



[1] J. P. Romanet, 2006
[2] M. Leonardi , 2007