3D4Amb

Using 3D for Rebalancing the Visual System of Amblyopic Children

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Outline

- Amblyopia and classical treatment
- Some recent advances
  - Virtual reality
  - Vision rebalancing
- Using 3D systems for Vision Rebalancing
  - Principle
  - Implementation
- Expected results

Amblyopia - prevalence

- is a disorder of the visual system that is characterized by poor vision or lack of vision in an eye that is otherwise physically normal.
  - Also knows as “lazy eye”
- Prevalence of amblyopia
  - Around 3% per cent in untreated childhood and adults [1-5%]
  - lifetime risk of visual loss of at least 1.2%
    - Ann L. Webber e Joanne Wood, «Amblyopia: prevalence, natural history, functional effects and treatment», *Clinical and Experimental Optometry* 88, n°. 6 (2005): 365-375.
- It is the first cause of poor vision in the young population under20 yrs
- **Context:** unilateral functional amblyopia

Treatment - occlusion

- Amblyopia is **reversible**
  - has to be treated within the sensitive period for visual development
  - Classical treatment: occlusion

PROBLEMS

- is unpopular
- requires very long periods of time
- disrupts fusion
- poor or noncompliance

effective treatments should address the compliance problem

Vision Rebalancing

- partial occlusion/penalization
  - good eye is penalized, not occluded
  - optically/filtering/ pharmaceutically

- By using virtual reality
  - Virtual Reality Applications Research Team (VIRART) – - Univ. Nottingham-IBiT ™

- By HMDs
  - Fateh and C. Speeg. Rebalancing the visual system of people with amblyopia "lazy eye" by using HMD and image enhancement. In VMR '09 LNCS, 5622

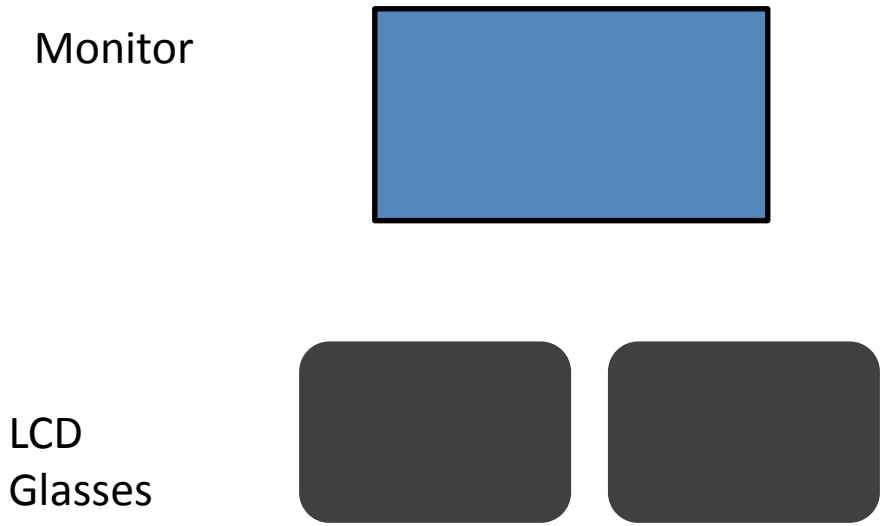
Goals of 3D4Amb Project

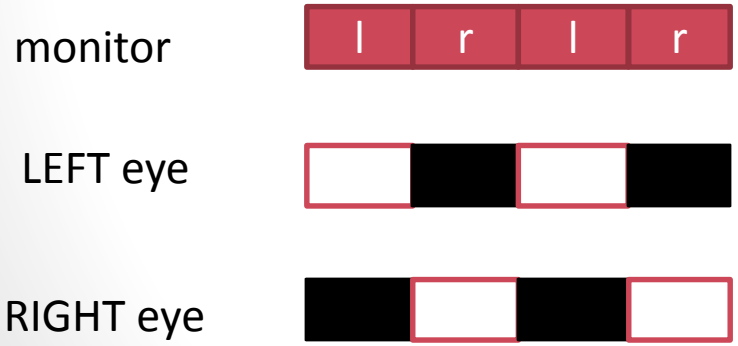
3D4Amb

- Vision rebalancing system that is
  - **Inexpensive**
    - use of standard technologies and/or appliances like TVs, PCs
  - **Friendly to use**
    - can be operated autonomously by the children themselves
  - **Suitable for domestic use**
    - without frequent time-consuming visits to the hospital.
    - suitable for frequent use at home
  - **Enjoyable**
    - recreational activities
  - **Easily extensible**
    - new applications, activities and programs to be added
  - **Monitorable**
    - The physician can inspect the data about the system use
- 3D technology with LCD active glasses

3D with shutter active glasses

- the monitor works at 120 Hz (double of the min speed) and shows alternatively two images
- The glasses are synchronized with it in order to show each image to each eye





NVIDIA® 3D Vision™

Advantages of this technology

3D4Amb

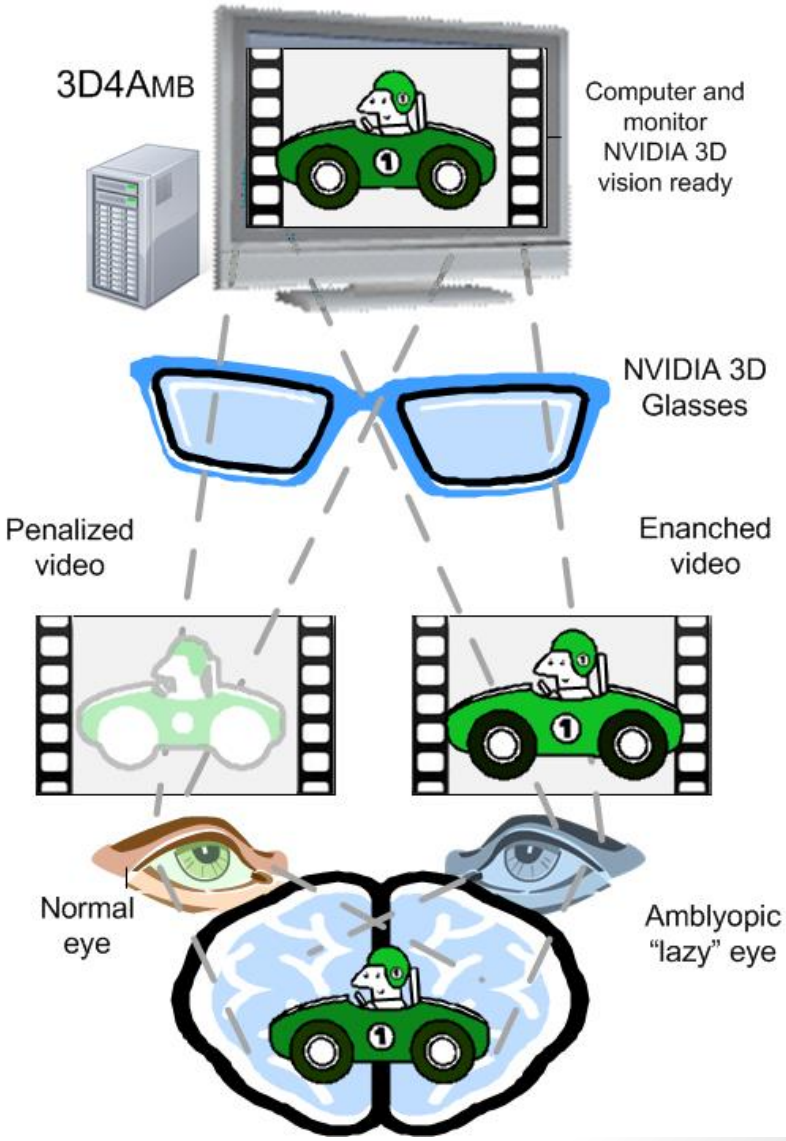
- **Full image quality per eye**
  - In 3D mode, each eye receives the full resolution of the display. The colors are not altered
- **Wide viewing angle for 3D**
  - There are no restrictions on the viewing angle in 3D mode. Users are free to move their heads without losing the 3D effect
- **Excellent 2D operation**
  - monitor can be reused for normal operation
- **Personalized fit**
  - glasses can be worn over prescription glasses.
- **Acceptable cost**

Vision Rebalancing by 3D

- The 3D system is not used to create the depth of a scene
- But only to send two different images/videos to the two eyes

- **normal eyes receives a penalized version**
- **amblyopic eye receives the enhanced version**

- Note: poor vision without glasses

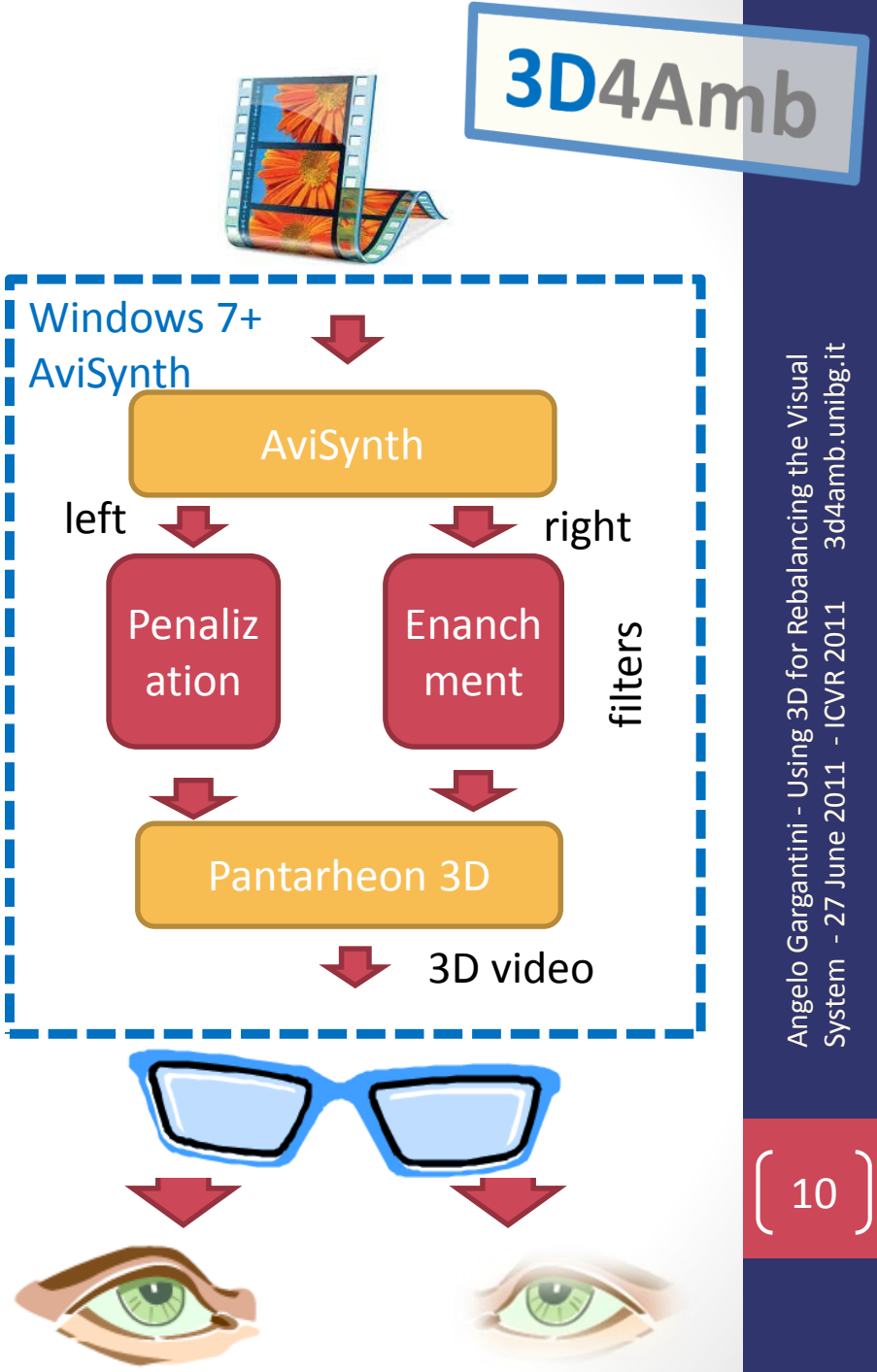


Implementation

- We use AviSynth
- *www.**avisynth**.org*
  - Frameserver – software
  - allows real time video rebalancing
  - Any video content can be processed.
  - No video "pre-processing"
  - Filters easily added and removed even during its use.
- + pantarheon toolbox
  - http://www.pantarheon.org/AviSynth3DToolbox/

1. The video is duplicated in two streams
2. Each stream is filtered
3. The two streams are recombined in a 3D video

- The process is a AviSynth script
  - simple commands
  - Working on an editor



Filters

- Penalizing filters:
  - reduce brightness and contrast
  - blur, unsharpen, noise introduction …
- enhancing filters
  - sharpen ….

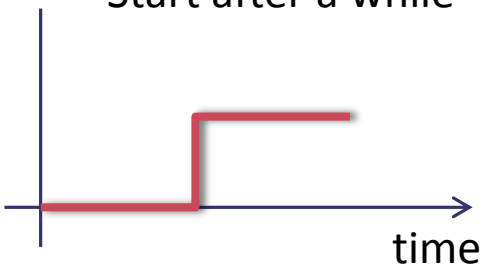
Filter Application

1. Continous

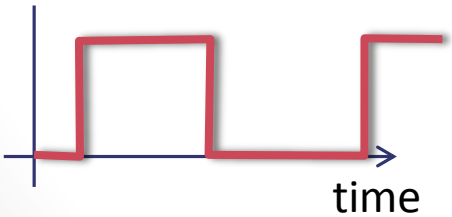
Similar to occlusion

2. Delayed

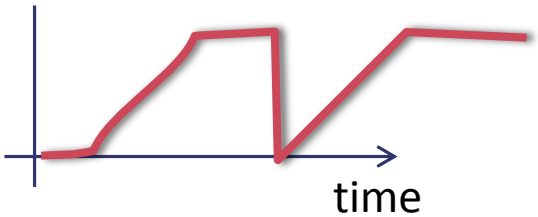
- Start after a while



3. Periodic



4. Gradual



Expected results

- No clinical trials (yet)

- Better compliance
  - appealing activity in a domestic environment, in a graduate and personalized manner
  - Poorer vision whithout glasses
- Binocularity
  - Both eyes are stimulated
- Video rebalancing
  - partial occlusion can achieve a better visual outcome then the complete patching

- Other uses of the 3D4Amb system:
  - screening, active treatment by video games, …

Conclusions

- 3D can be used for vision rebalancing
  - The good yes is penalized
  - Amblyopic eye is stimulated
  - Software implementation using avisynth
  - Final goal **better compliance**
- Web site:
  - 3d4amb.unibg.it
- Open for collaborations …
- Future work
  - …