ARTIFICIAL SIGHT: GIVING THE BLIND A SECOND CHANCE

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Overview

 Background
  • Medical Information
    ○ Human Eye
    ○ Statistics

 Focus
  • Visual Prosthesis
    ○ The System
    ○ Retinal Implant
    ○ Phosphenes
  • Engineering Fundamentals
The Human Eye

- Parts of the Retina
  - Blood Vessels
  - Macula
  - Photoreceptors
    - Rods and Cones
  - Retinal Pigment Epithelium
  - Choroid
  - Sclera
Retina Rods and Cones

- Cones located about the fovea (6-7 million)
  - Color & visual acuity
- Rods (120 million)
  - Night vision, motion detection, peripheral vision
Retinal Prostheses Candidates

- Retinal Degenerative Diseases
  - Retinitis Pigmentosa
  - Age Related Macular Degeneration
Retinitis Pigmentosa
Macular Degeneration
Wearable Vision Prosthesis System

[1]
Wearable Camera

- Camera
  - Collects data
- Infrared Eye Tracker
  - Adjusts camera position
Wearable Image Processor

- Portable
- Micro Processor
  Used in PDAs/PMDs
- Dual core
  - Reduced instruction set microprocessor
  - Digital signal processor
  - Separate clocks

[1]
Image Processor System

Diagram showing components such as Camera, Bluetooth, Ethernet, RS232, USB Bus, OMAP, ARM, DSP, Flash, and SDRAM.
The ARM program is the master element of the system in that it performs the following tasks:

1. Initializes hardware/software resources on start up.
2. Acquires image frames from the camera continuously.
3. Delegates image-processing tasks to the DSP program.
4. Transfers stimulus commands to the output interface(s).
5. Handles network communication requests from the Blue-tooth interface.
6. Listens and responds to commands from the connected remote supervising tool.
Radio Frequency Transceiver

- Used for communications between the Image Processor and the retinal implant.
- Allows for wireless implant
Retinal Implant

- Attached directly to the retina
- Stimulates ganglion cells of the retina, to communicate with the optic nerve
Fundamental Steps for Image Processing of a Visual Prosthesis

[Image: Diagram showing the steps from Image Acquisition, Image Enhancements, Image Pixelization, to Command Generation]
Down Sampling

- A reduction in the rate which a signal, in this case, an image is sampled.
- This is easily accomplished by selecting every $M^{th}$ term

$$h(k) = g(Mk)$$
Visual of Down Sampling
Reading via Zoom
Gaussian Smoothing
Gaussian Smoothing

\[ G(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} \]
Displacement Correction

- Sampling Remapping Tool
  - Needed when perceived view of the subject varies from the original image
Phosphene Realization
References


Questions?

- http://www.youtube.com/watch?v=Zoo5K2EqK3A&feature=related
- http://www.youtube.com/watch?v=8U-xLaAGSV0