RESEARCH ON RE-SHOOTING COUNTERMEASURES

Isao ECHIZEN

National Institute of Informatics

Background: analog-hole problem

Conventional problem

- Originally intended to resolve security problems with analog-output terminals of digital equipment
- Resolution by replacement of digital terminals

Rise of new problem exploiting monitors and screens

- Trend of increasingly high-quality monitors and cameras makes it easy to reshoot presented content

    -> Distribution of illegally <u>re-shot</u> content
    - Ex. re-shoot PC monitors with cell-phone cameras -> upload shot content
    - Ex. re-shoot theater screens -> sell pirate DVDs
        - Loss of USD 3B per year (survey of Motion Picture Association of America)

Conventional measures against re-shooting: use of digital watermarks

Watermarked film (theater ID embedded)

Digital films

Internet

• **Enhance measures against illegal shooting**
• **Suspect inside job**

Illegal shooting

Pirate DVDs

WM reveals theater where illegally shot

WM detection

- ◉ Embed theater ID WM into digital cinema film.
- ◉ Detect WMs in pirate DVDs and identify flow of illegal distribution.

But: no control of re-shooting

Re-shooting countermeasure
- Objective and approach -

Objective:

- ◉ Establish countermeasure to stop re-shooting
 - • No new function is added into existing user-side device (ex. cam)

Approach:

- ◉ Use of difference between sensory perceptions of humans and devices
  - • Destroy shot content using invisible signals which add noise to content shot through CCD/CMOS devices
    - ○ Employ near-infrared signals as noise signals: CCD and CMOS react to them

Human-based perception

Device-based perception

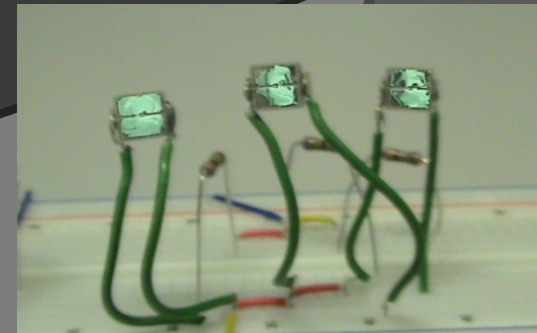Signal to be generated
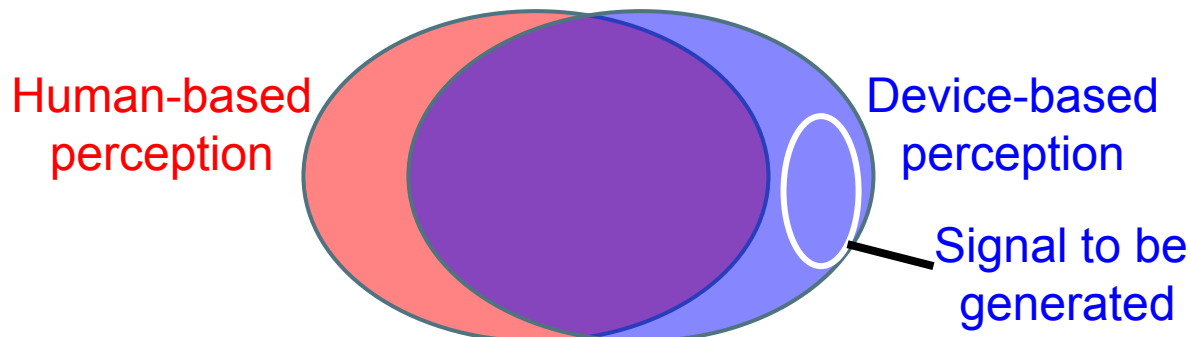
Properties of noise signals

- Wave length of noise signals
  - Visible range of human eyes: 380nm-780nm
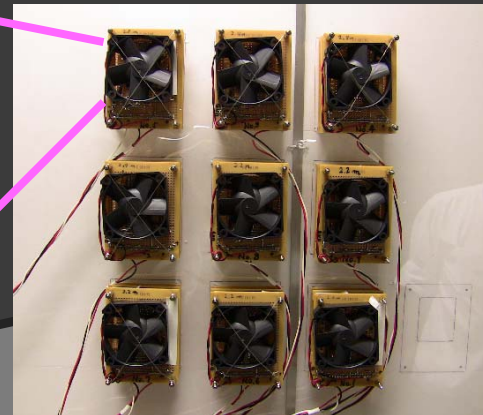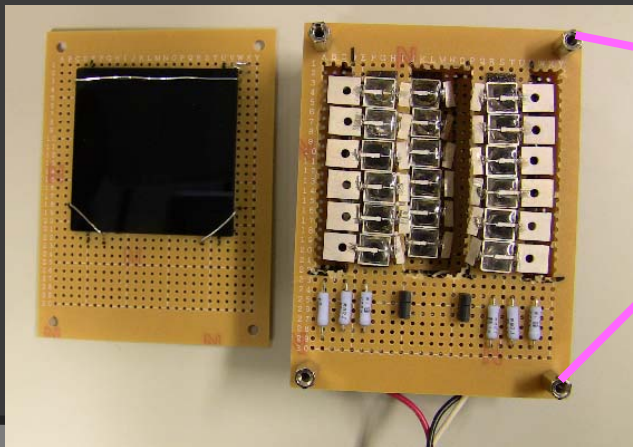 - Visible range of CCD/CMOS devices: 200nm-1100nm
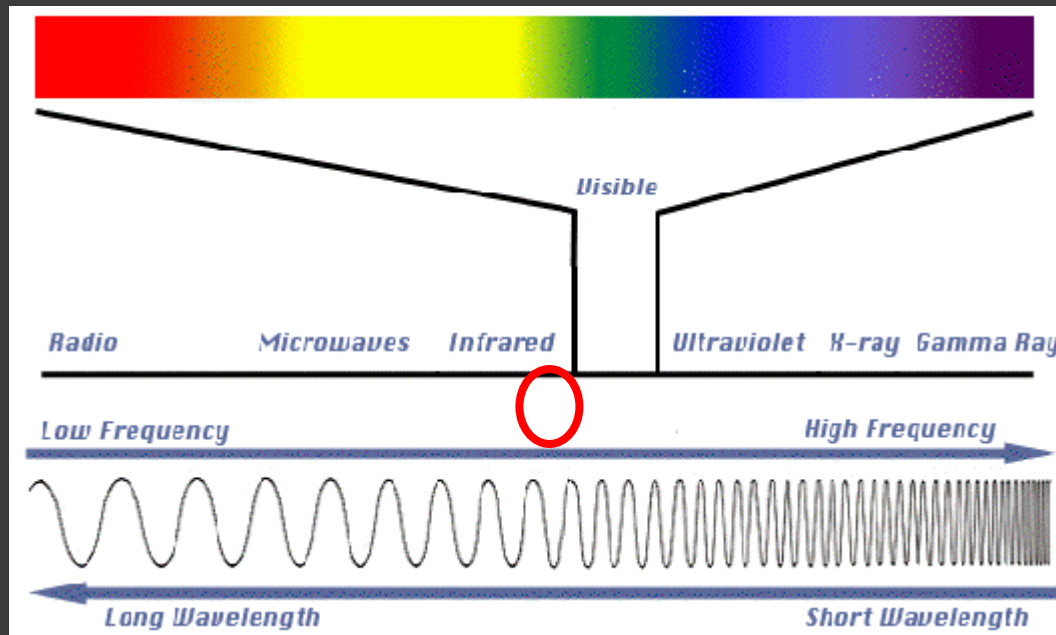
Near-infrared signals
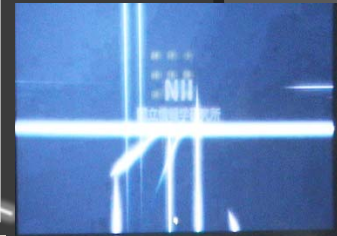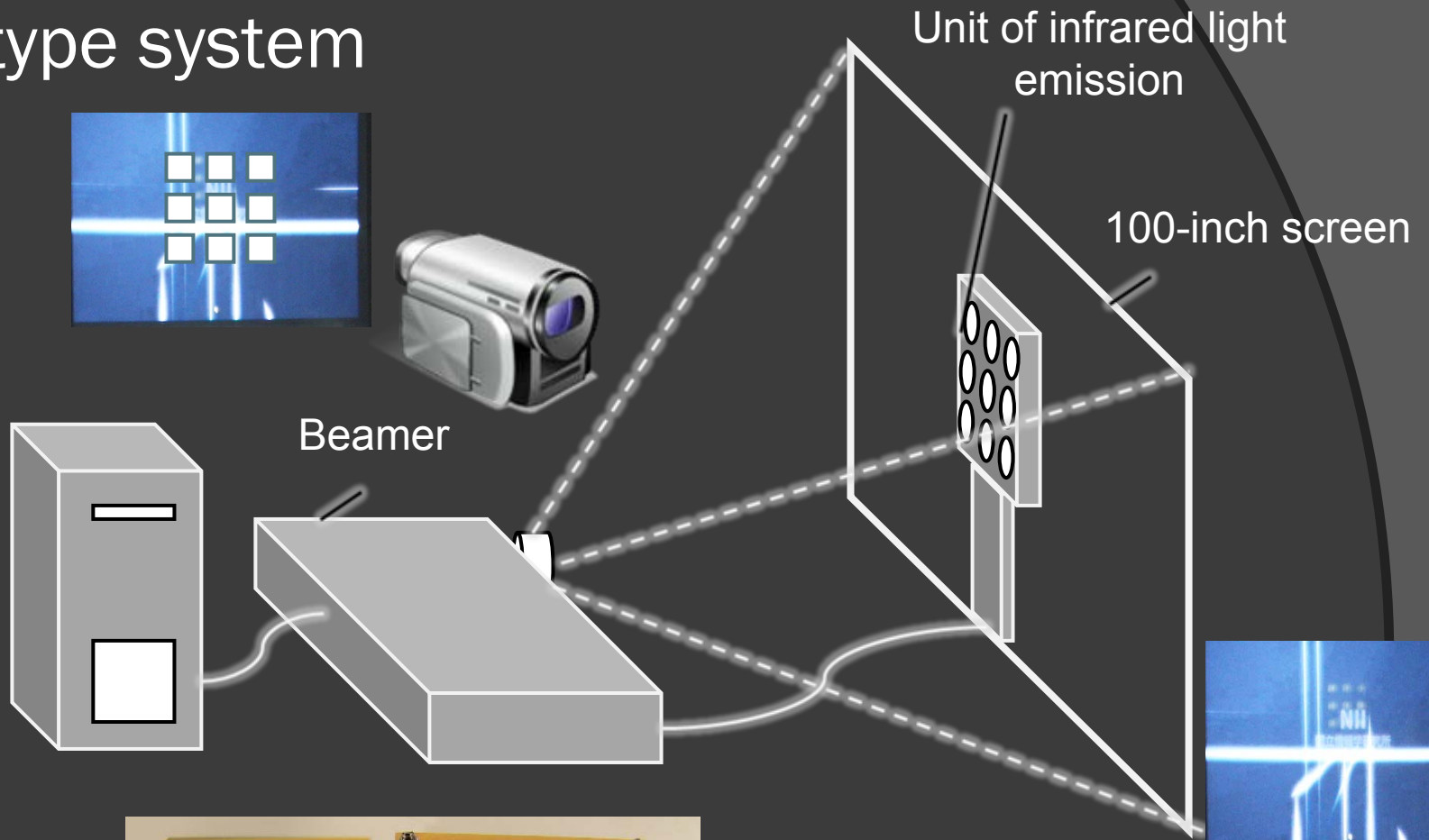

  - Use of near infrared LEDs
    - Infrared LEDs: no harm to human, verify safety

Prototype system

Unit of infrared light emission

100-inch screen

Beamer

Prototype system

Front side

Back side

- ◉ Movie screen: many holes (1-2mm in diameter) to combine sound and video
- ◉ Unit of infrared light emission: place on back side of screen
  - ◉ Infrared light: get through holes
- ◉ No need to modify screen