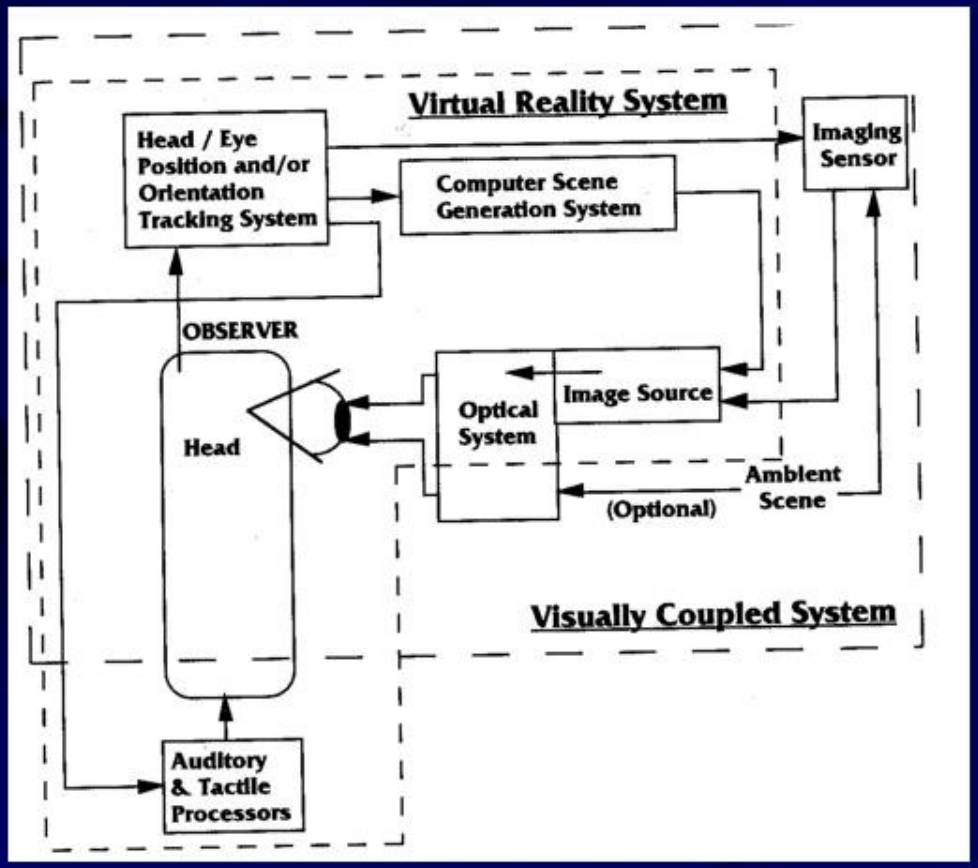
Visually coupled system requirements

COM 429

Visually Coupled System

- A “special subsystem” which integrates the natural visual and motor skills of an operator into the system he is controlling.
- 3 major components
  - HMD
  - Means of tracking the head or eye pointing direction
  - Source of visual information which is dependent on the head or eye viewing direction

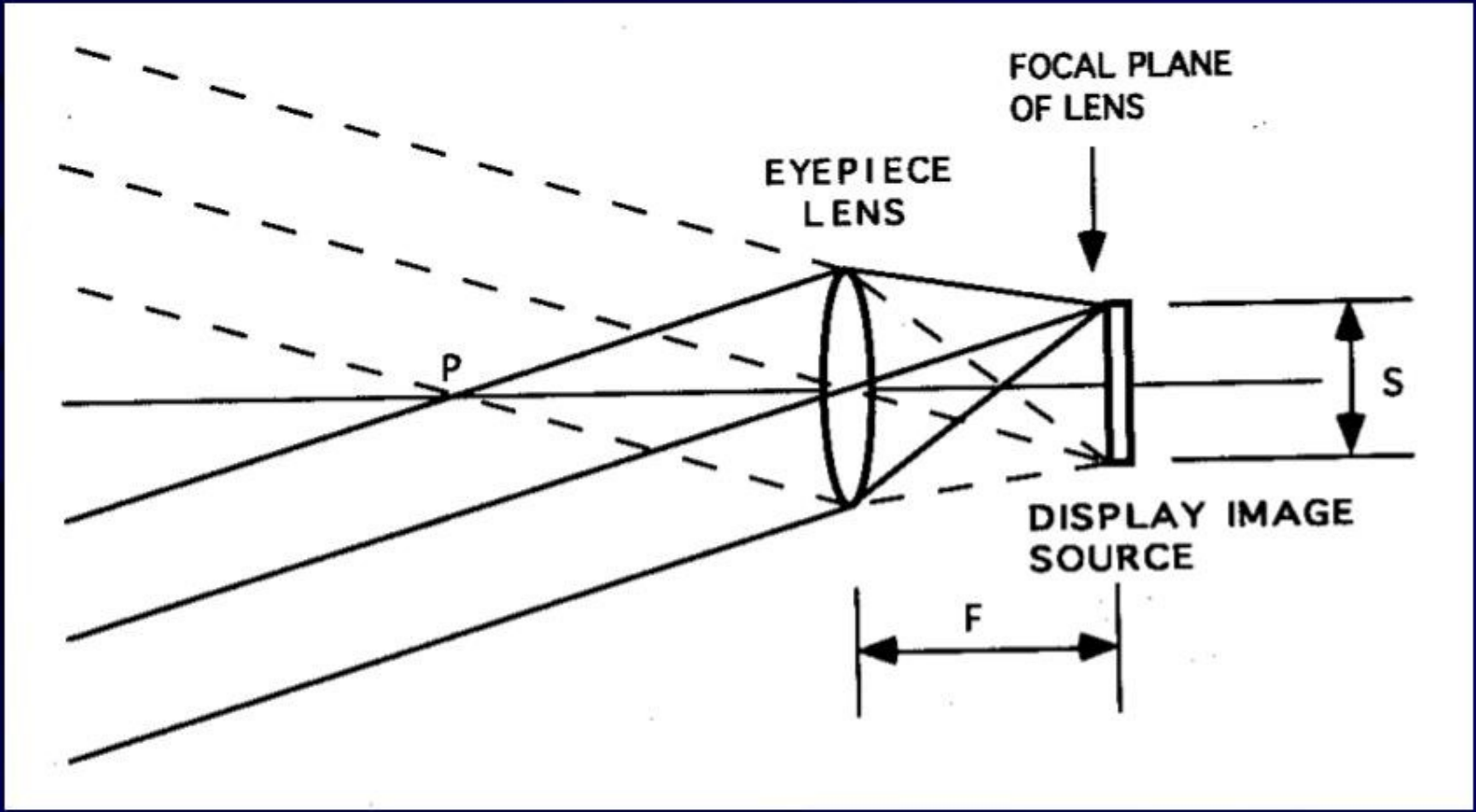
Major components of virtual reality and visually coupled systems



Head/Helmet mounted display

- Optical System
  - Simple Magnifier
  - Compound Microscope
- Display Image Source

Simple Magnifier



Simple Magnifier (contd.)

- Single lens system
- Simple and inexpensive

Field of view (FOV) of this system:

$$FOV = 2\arctan(S/(2F))$$

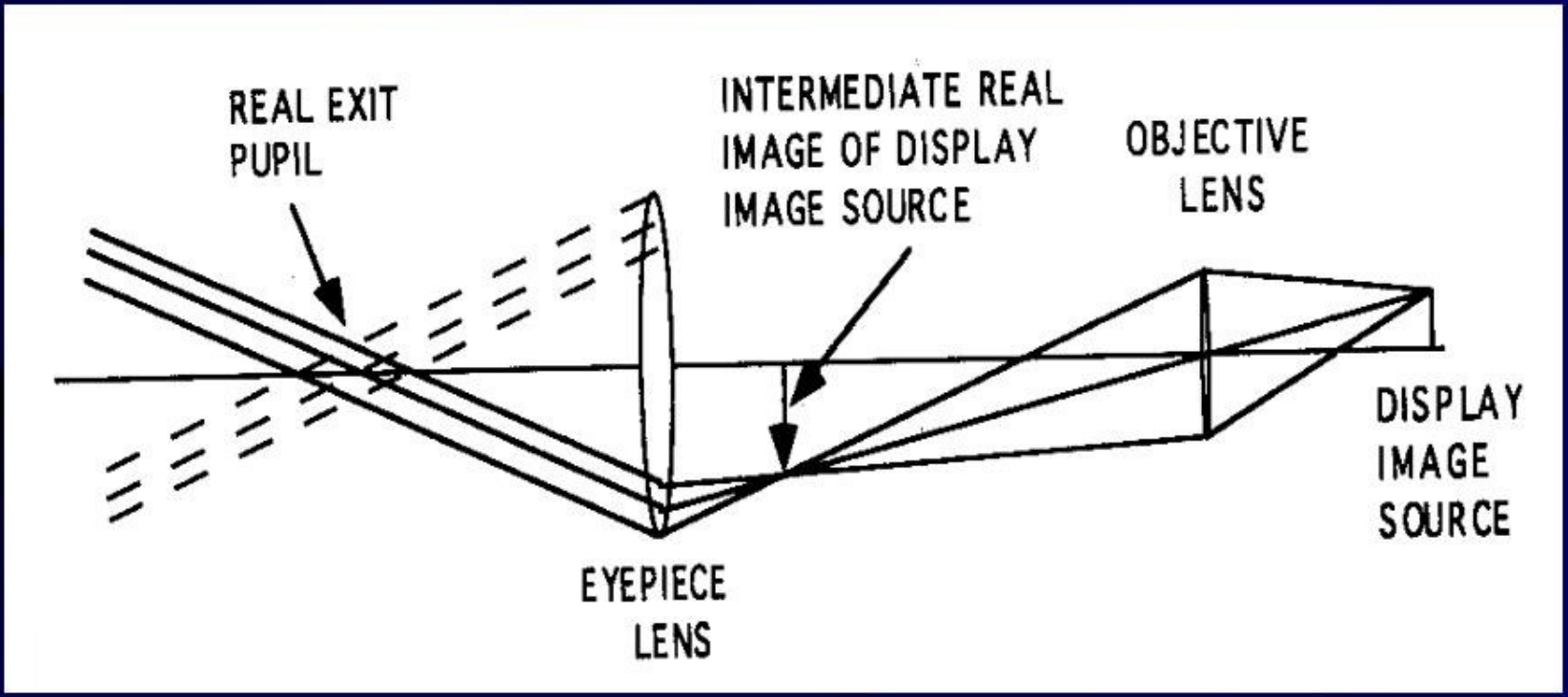
S – Linear size of the display image source

F – Focal length of the lens

Characteristics of Simple Magnifier Optical System

- Lens focal length
- Diameter of the lens
- Format size for which the lens is designed
- Imaging quality of the lens

Compound Microscope HMD Optical System



Features of compound microscope

- The observed image is inverted compared with image on the display(unlike the simple magnifier approach)
- The existence of a real intermediate image can be a problem

Characteristics of Compound Microscope

- Exit pupil size
- Exit pupil location(eye relief)
- Input format size
- Field of view

Image sources for HMD

Image source-Key component technology

Two types :

- Emissive Display Image Sources
  - -Lasers
  - -Electroluminescent Displays
  - -Field-emission Displays
  - -Miniature CRT

Image sources for HMD (contd.)

- Non-emissive Display Image Sources
  -Subtractive color Liquid Crystal Displays

Helmet/Head Tracking systems

Visually coupled systems(VCS) &VRS have their visual interface to the human driven by:

- Head orientation and position(HOP)information
  - Transmitters and receivers
  - Ultrasonic, magnetic or light energy
  - Simple sighting reticle
- Eye Line-of-sight (LOS) information

Parameters of Helmet P&OT System

- Line-of-sight, orientation, position
- Head coverage or motion box
- Static accuracy
- Resolution & Repeatability
- Update rate & Refresh rate

Parameters of Helmet P&OT System (contd.)

- System Interfaces
- Other System issues
  - -Number of transducers that must be installed
  - -Type of transducer alignment

System Integration

Parameters used to characterize a VCS:

- Ocularity (binocular, biocular, monocular)
- Color (monochrome, polychrome)
- Type I or II (combiner, no combiner)
- Monocular field of view
  - Angular sub tense of the displayed image as measure from the pupil of one eye
- Total field of view
  - Angular size of the virtual image visible to both the eyes expressed in degrees

System Integration (contd.)

- Binocular field of view (if applicable)
  - Refers to the size of the display field which is visible to both the eyes
- Field of regard
  - It is the angular size of the visual scene that is within the range of viewing angles possible with the particular HMD/Tracker/Sensor system

System Integration (contd.)

- Resolution
  - Method of providing limited amount of information regarding image quality aspects of a display
- Focus (image distance)
- Luminance
  - Corresponds to the human visual sensation of brightness measured in foot - lamberts
- Combiner ratio
  - If HMD uses combiner to super-impose HMD image on the real world, the reflection and the transmission co-efficient might be expressed as a ratio

Display Image Source/electronic interface

Two major interface issues that affect the performance of the head mounted image sources are:

- Remoteness of the image from its drive electronics
- Display Artifacts

Applications of VCS &VCS Components

- Military systems and applications
- Civilians systems and applications
- http://www.sid.org/sid95/applicat.htm

References

- Performance and head movements using a helmet-mounted display sized fields-of-view
  — Maxwell J. Wells, Michael Venturino.

- Overlap Binocular Field-of-View flight Experiment
  — T. H. Bui, R. H. Vollmerhausen and B. H. Tsou.

- Head Mounted Displays
  — James E. Melzer & Kirk Moffitt.