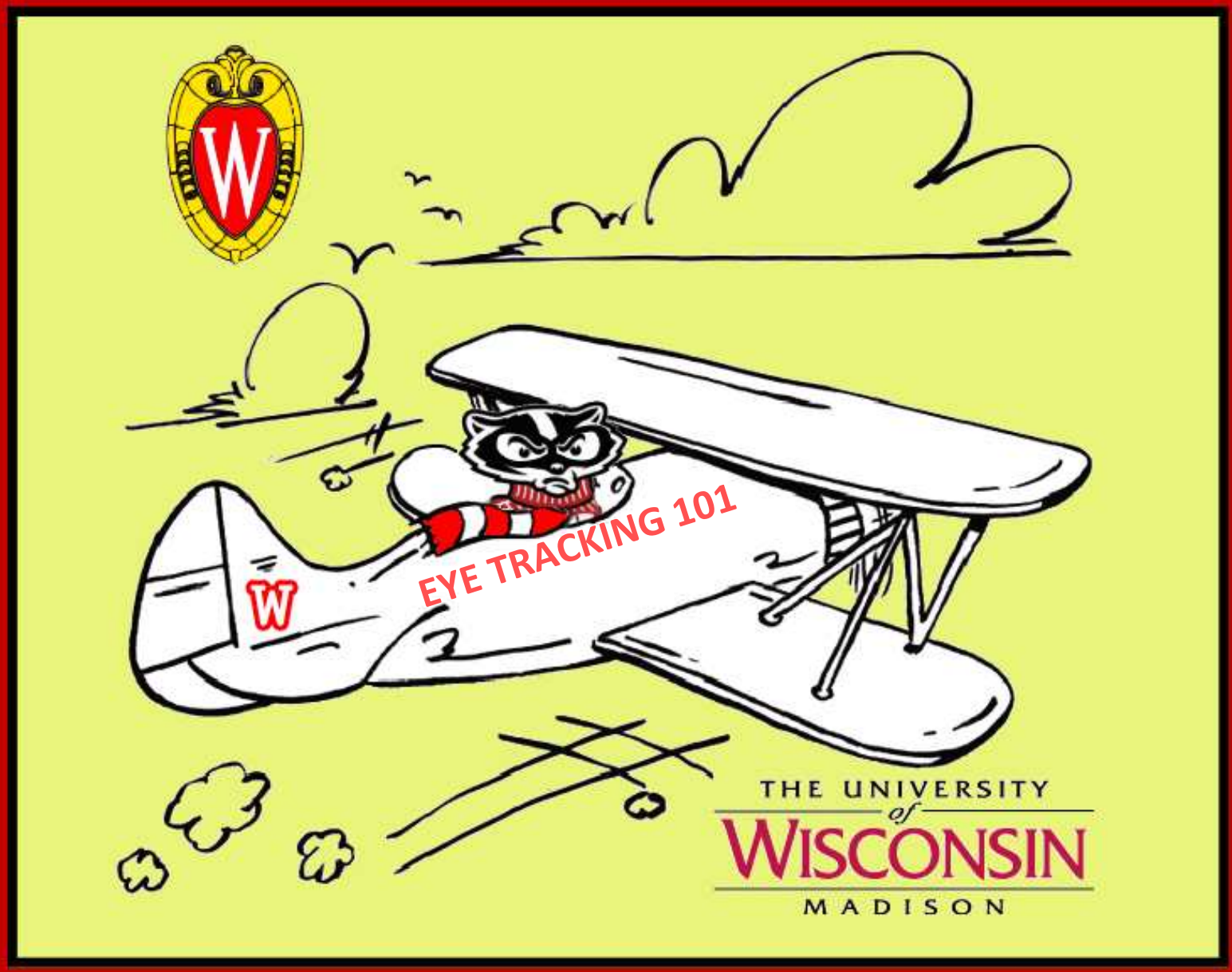
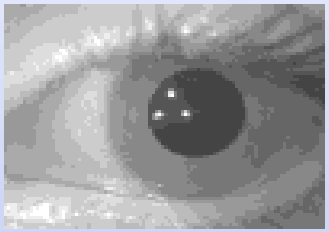


ychen228@wisc.edu Max Chen
Revised: 2009. Nov-18

Content

1. *How it Works?*
2. *Setting and Parameters*
3. *Before We Start*
4. *Some applications of Eye-Tracking (in Aviation)*

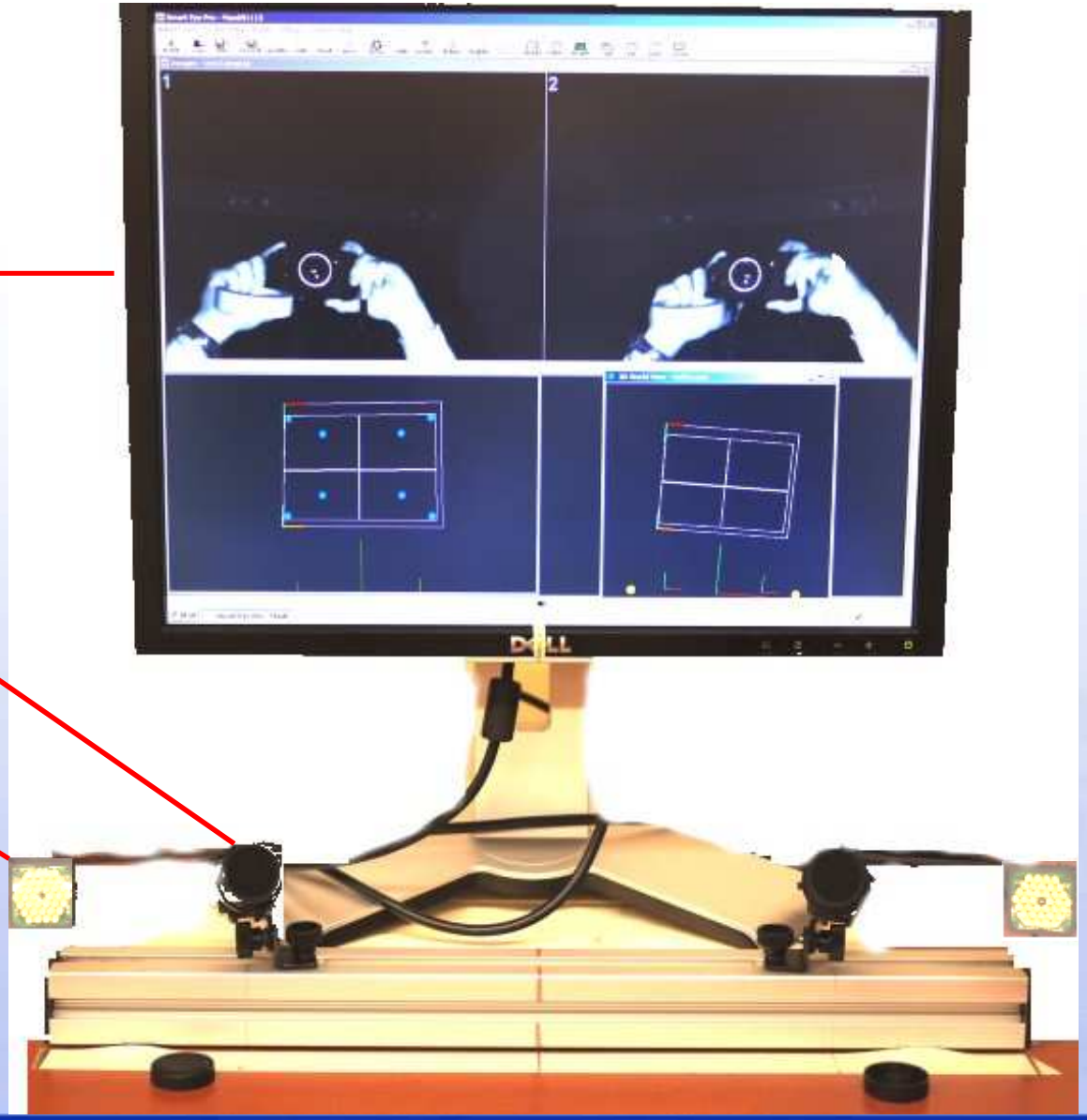


1. How it works?

→ Pupil + Iris Detection

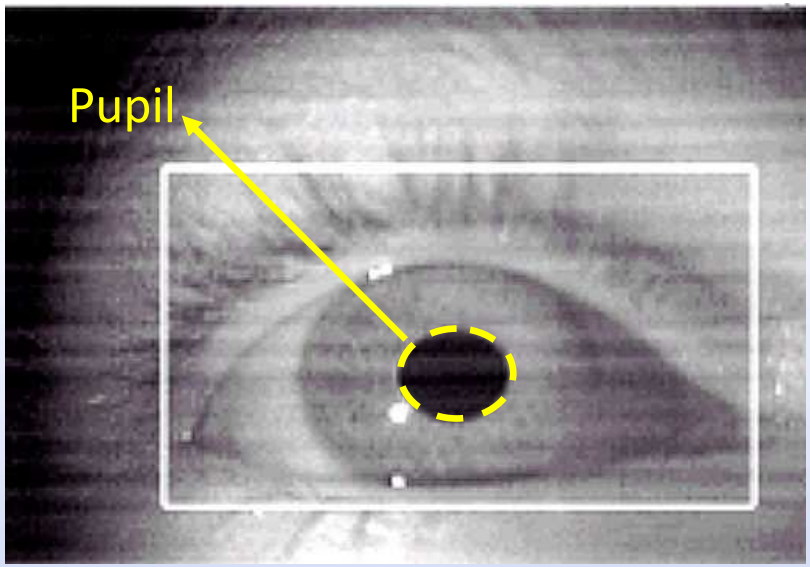
→ Corneal Reflection

Eye Tracking System

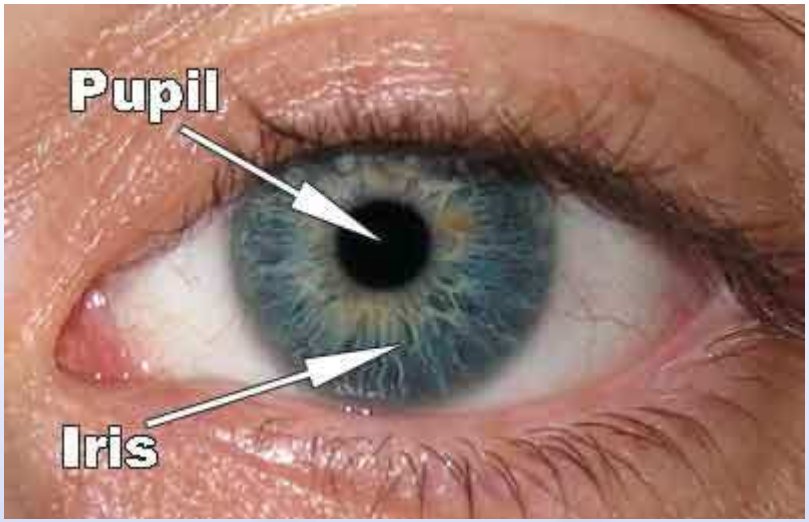


1.1 Eye Tracking Theory - SE

Pupil + Iris Detection



Under the IR Light



Natural Light

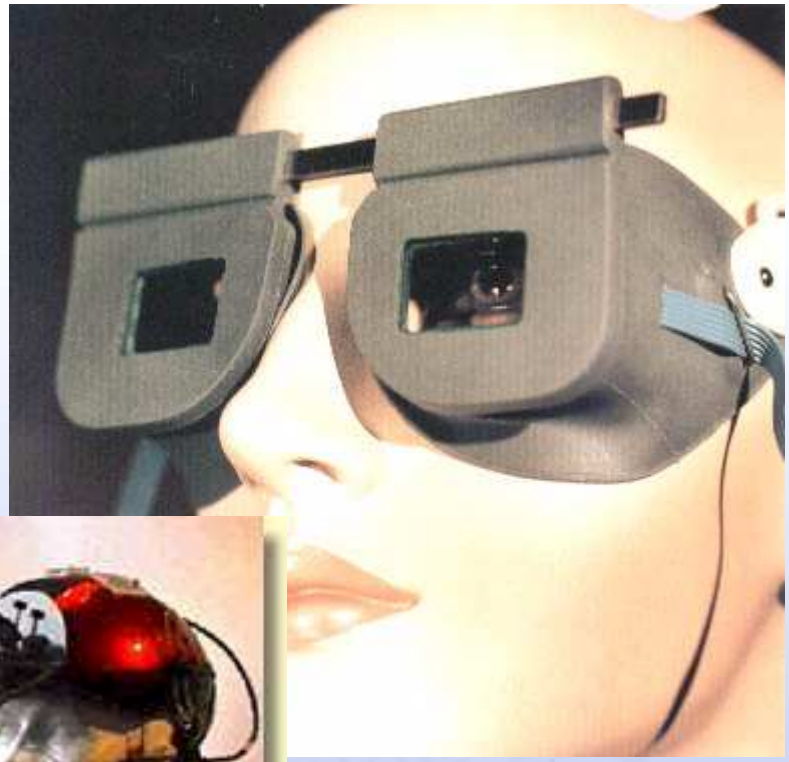
→ According to the pupil's position and the iris' shape to decide the POG

(Traditional Way – Head-mounted)

POG = Point of Gaze

1.2 Head-mounted Style Eye-Tracking System

[SensoMotoric Instruments GmbH, TAUCHI]



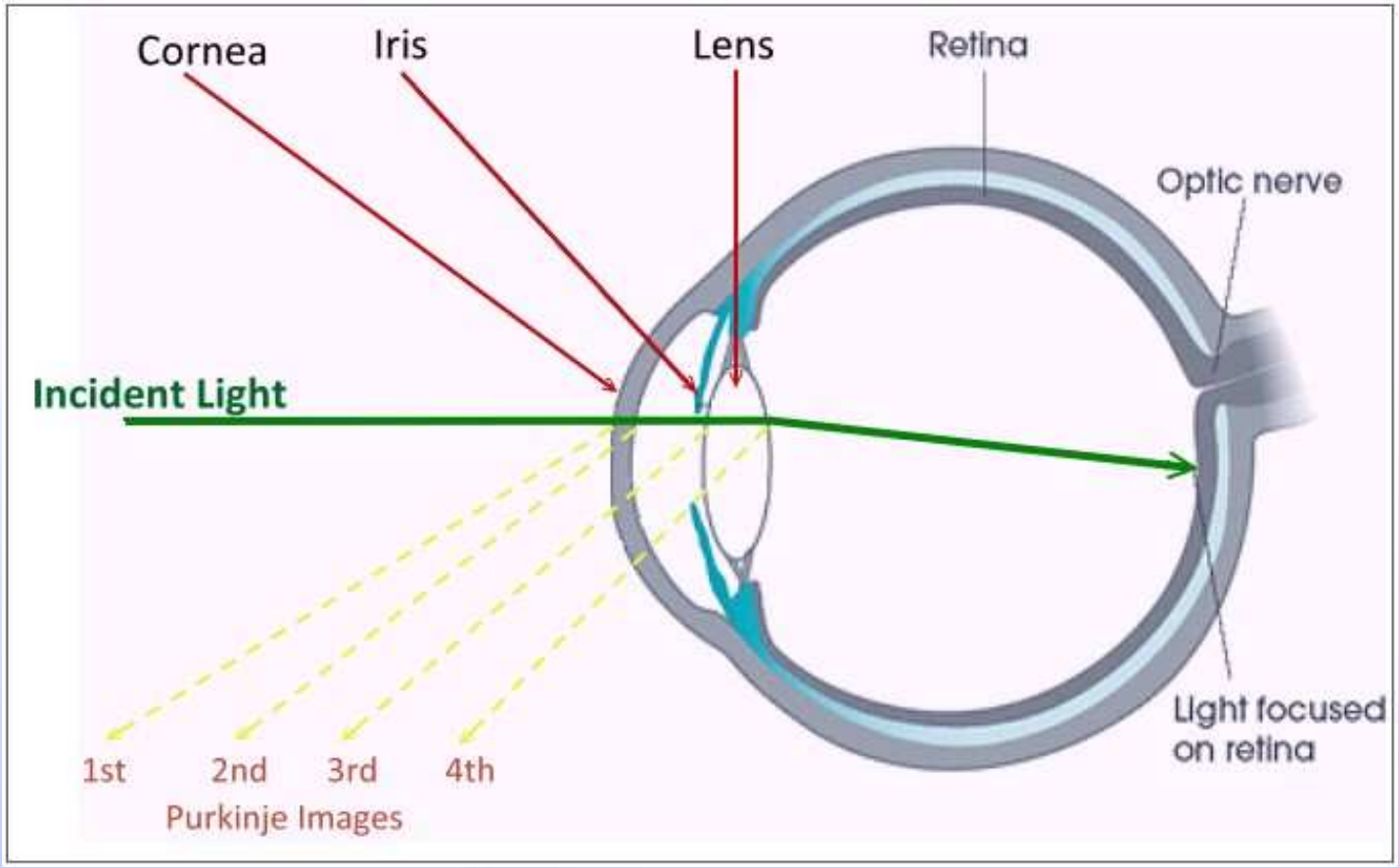
[Iota AB, EyeTrace Systems]

[Mooij Holding]

Source: Hyrskykari (2001)

1.3 Eye Tracking Theory - SE

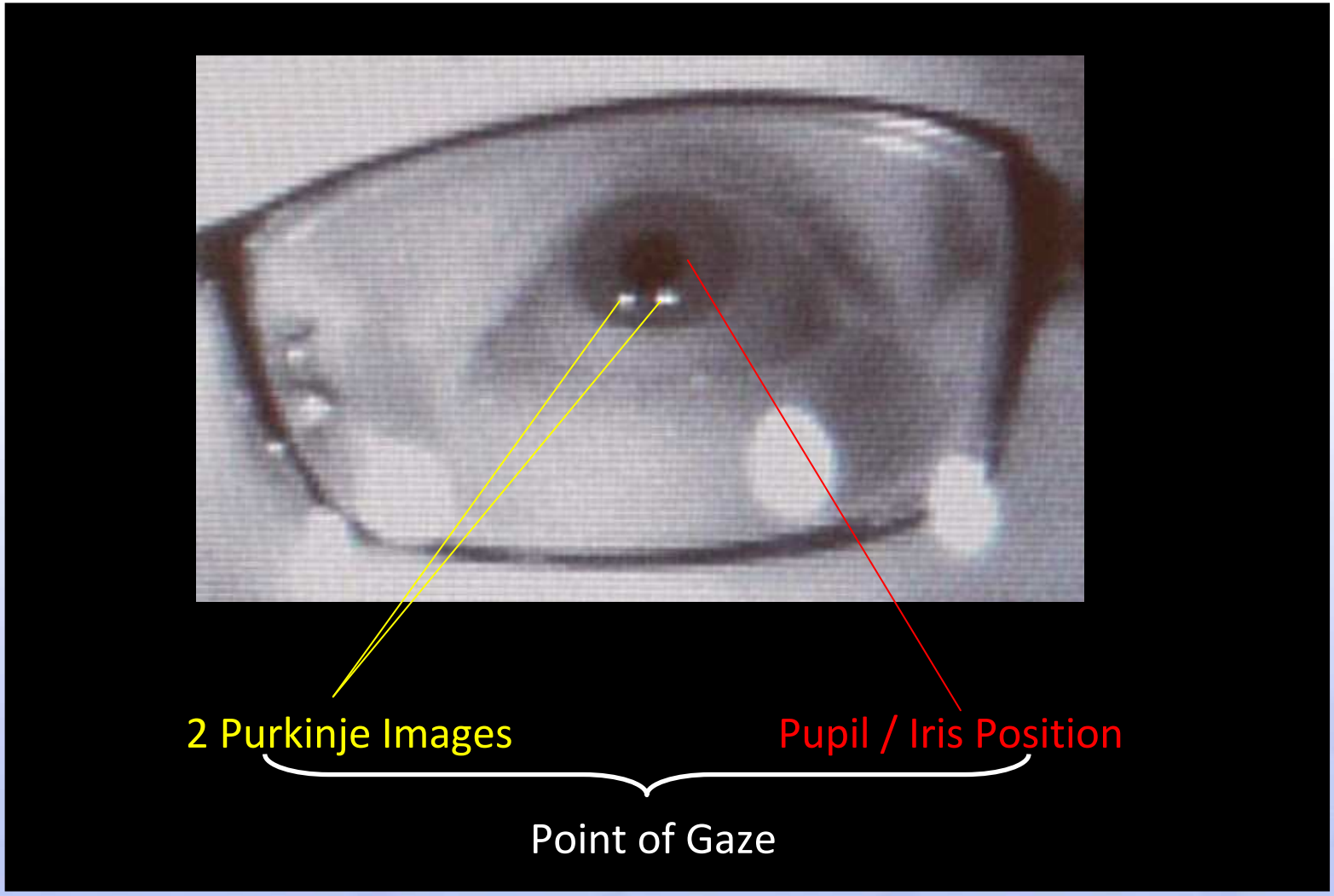
Corneal Reflection (Purkinje Effects)



→ Identifying the PI's position on cornea to decide the POG

1.4 Eye Tracking Theory - SE

Smart Eye: Eye Tracking System



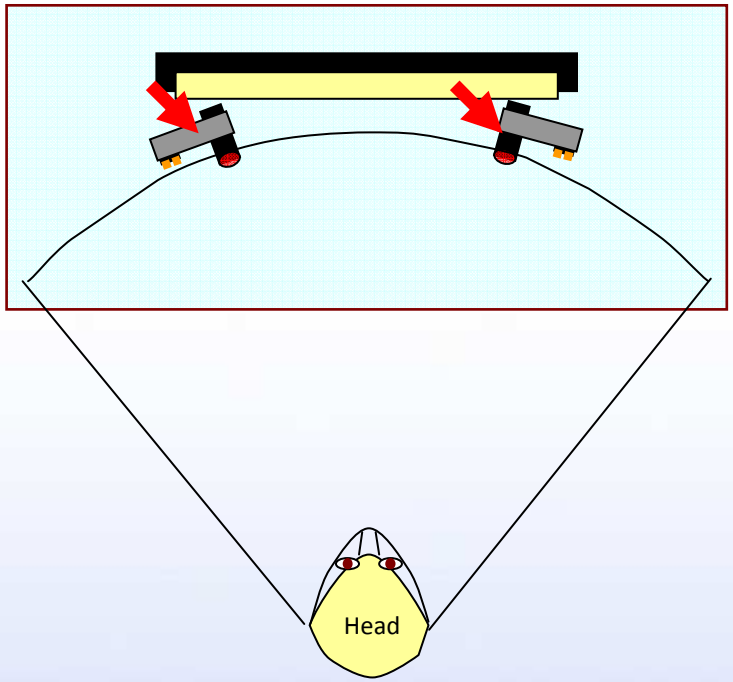
Movie Exhibition

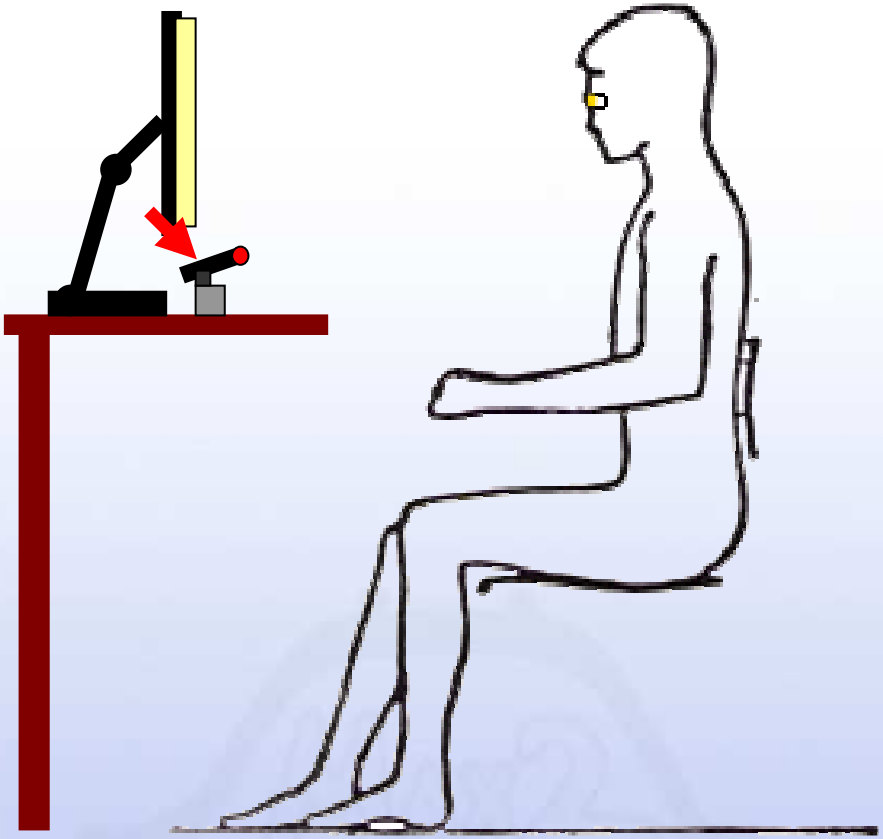
2. Basic Setting & Parameters

→ 3 Angles : **AoV**, **VAC, HAC**

→ 4 Distances: **DoC, DSO, HDCE,VDCE**

2.1 Basic Setting: Noun - Cameras





Cameras

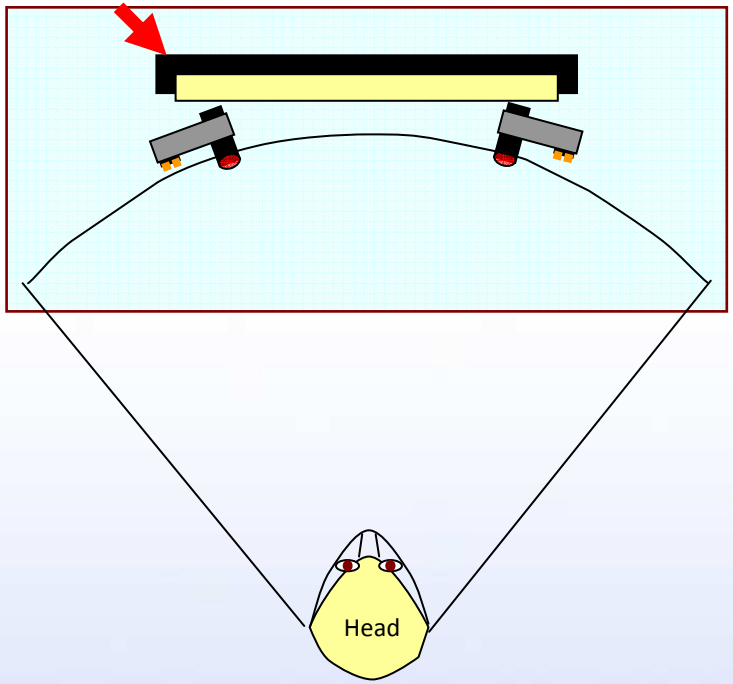
Detect the Point of Gaze

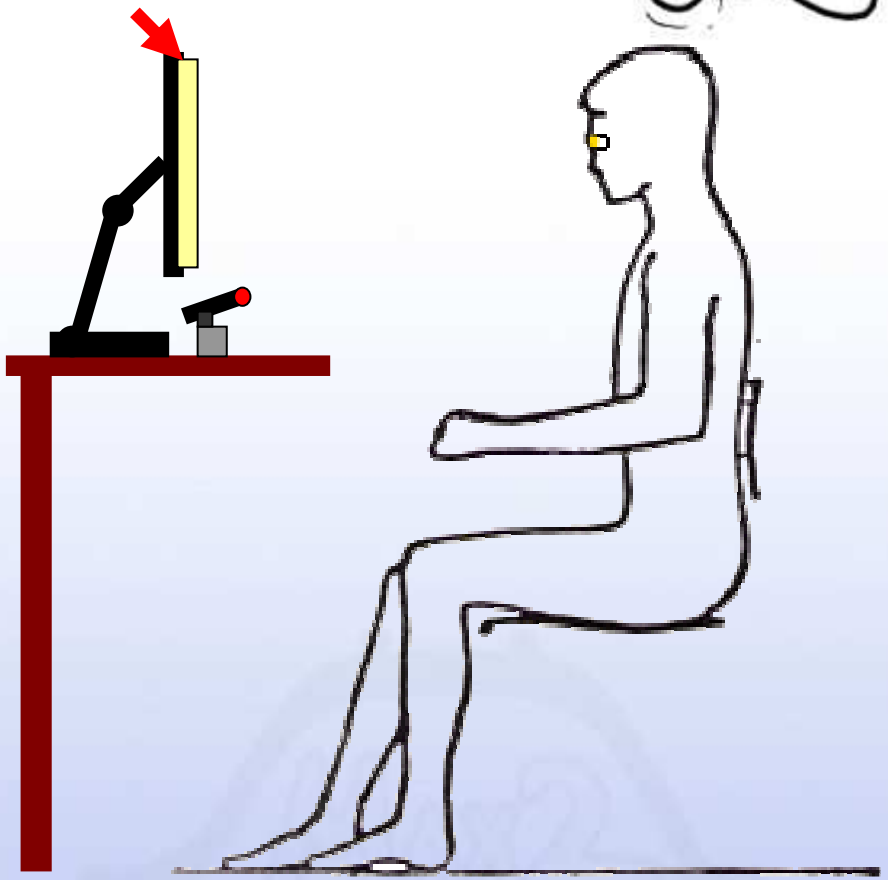
SONY HR-50, HR 8.0mm lens

CCD: 1/3” (4.8mm x 3.6mm)

Focal Length: 8mm

2.2 Basic Setting: Nouns - Screen





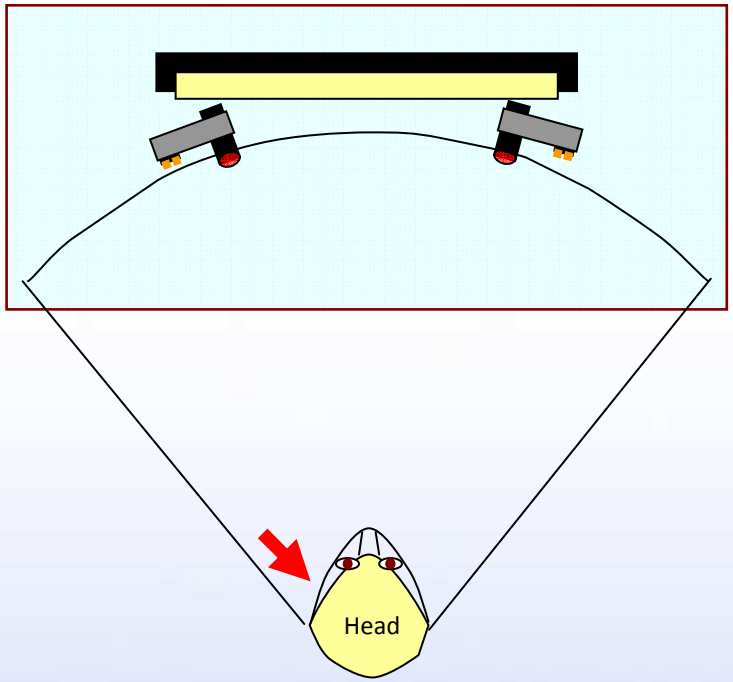
Screen

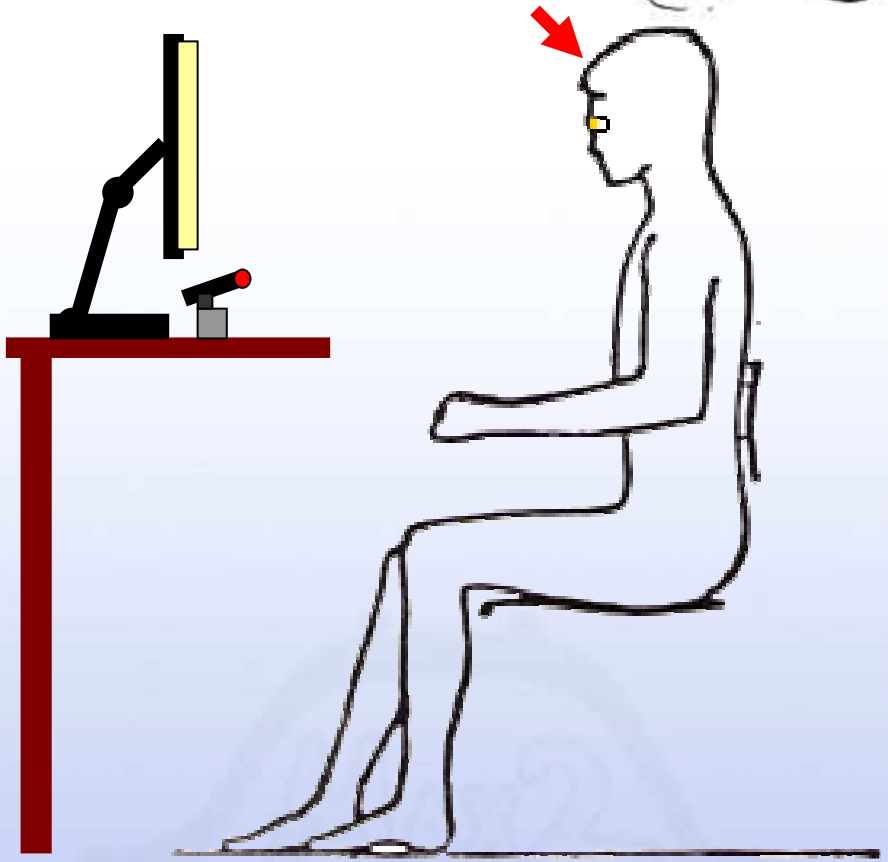
The Target

→ Factor to decide # of cameras

→ What is the size of Screen?

2.3 Basic Setting: Nouns - Object





Object

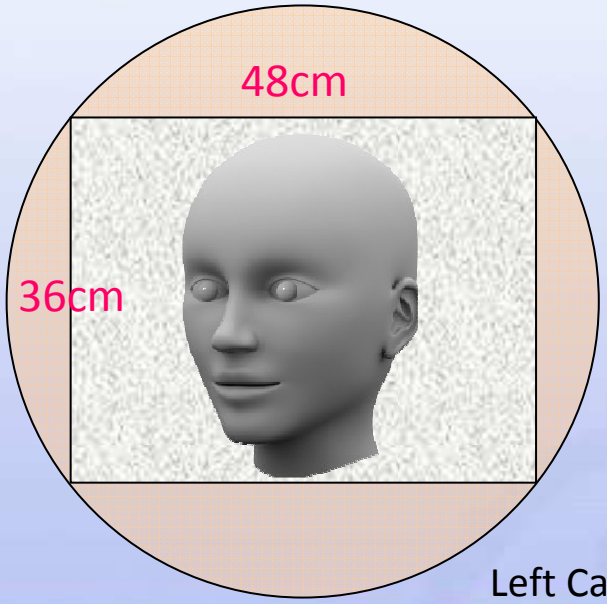
The Person in Experiment

2.4 Parameters: Angles - AoV

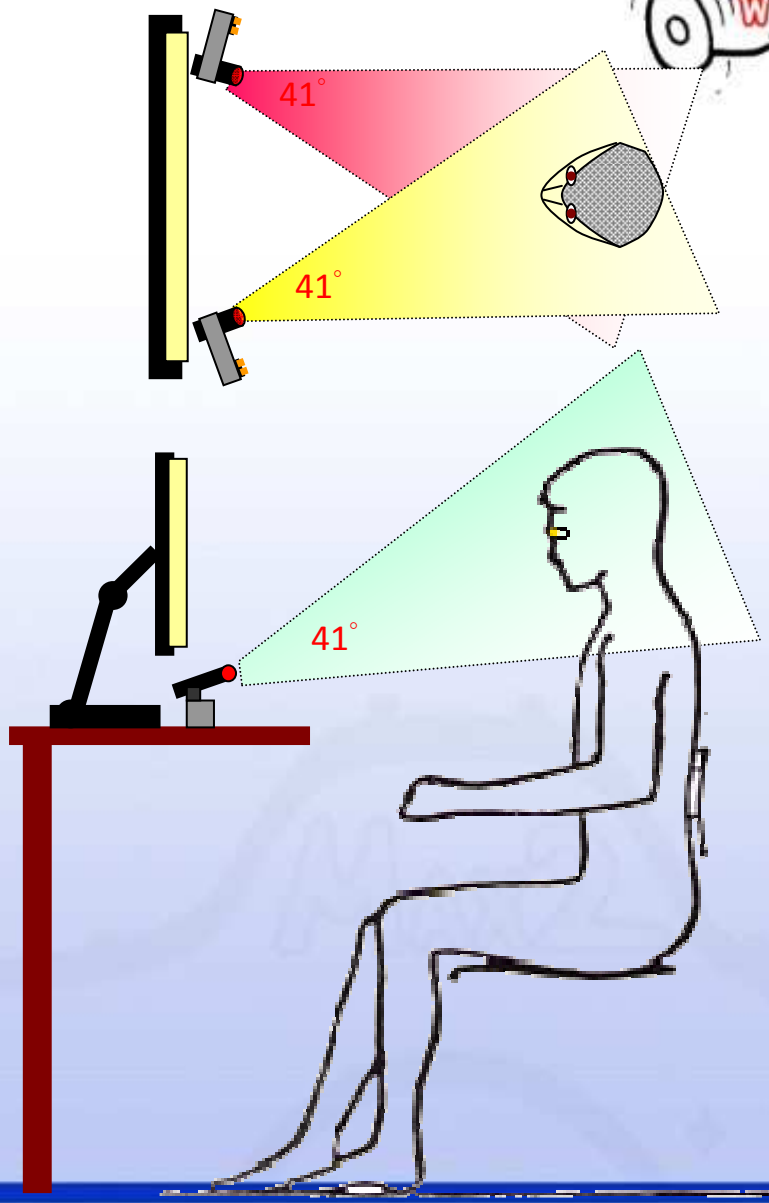
Angles of Views

1. Subject to the Camera Lens
2. 8mm (1/3”CCD) = 41°
3. Field of View, when

   DSO is 80 cm (31 inch):



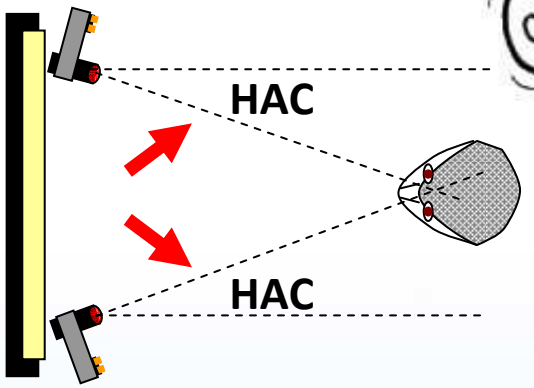
Left Camera



2.5 Parameters: Angles – VAC & HAC

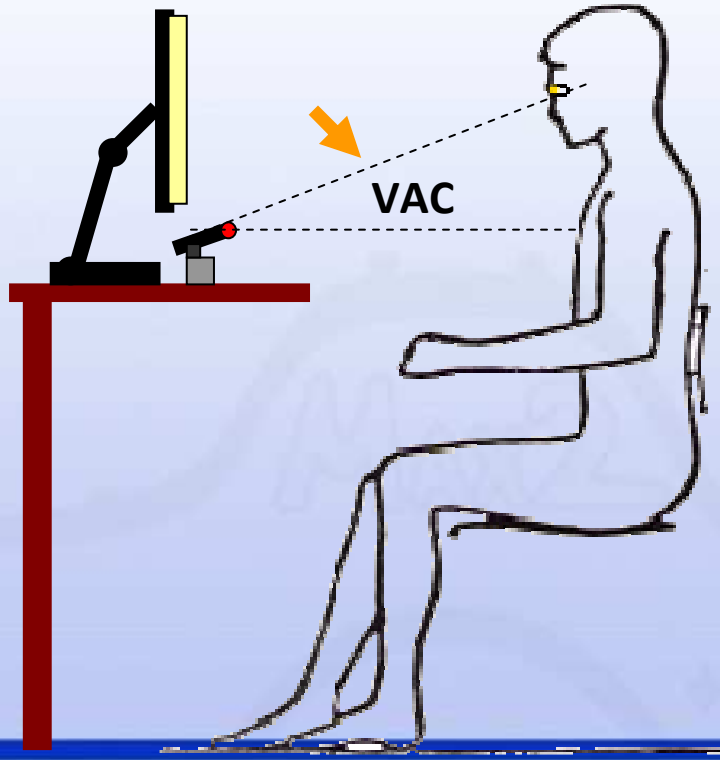
Horizontal Angles of Cameras (HAC)

1. Subject to DoC and DSO
2. Limit to : 1°- 15°
3. Current Setting : 10°



Vertical Angles of Cameras (VAC)

1. Subject to DSO and VDCE
2. Limit to : 1°- 25°
3. Current Setting : 20°



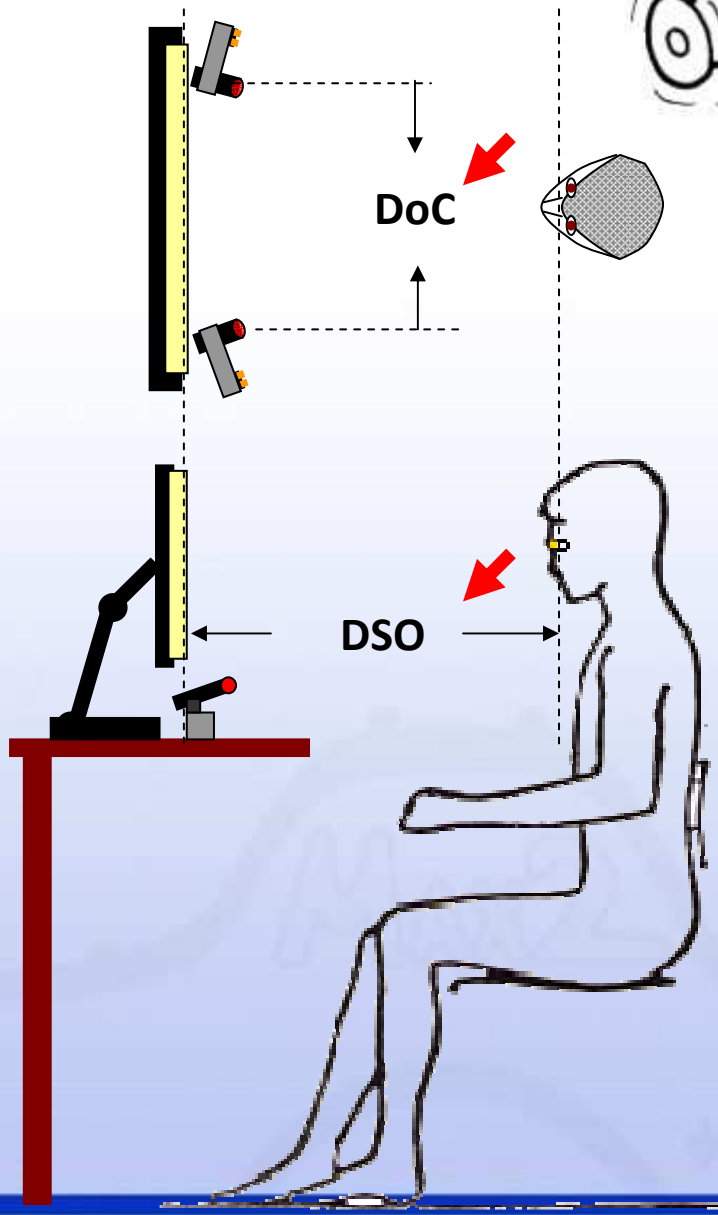
2.6 Parameters: Distance – Doc & DSO

Distance of Cameras (DoC)

1. Key Control Factor
2. Limit to: 20-30cm / 8-12inch
3. Current Setting : 30cm (12inch)

Distance from Screen to Object (DSO)

1. Key Control Factor
2. Limit to: 55-125cm / 22-49inch
3. Current Setting : 80cm (31inch)



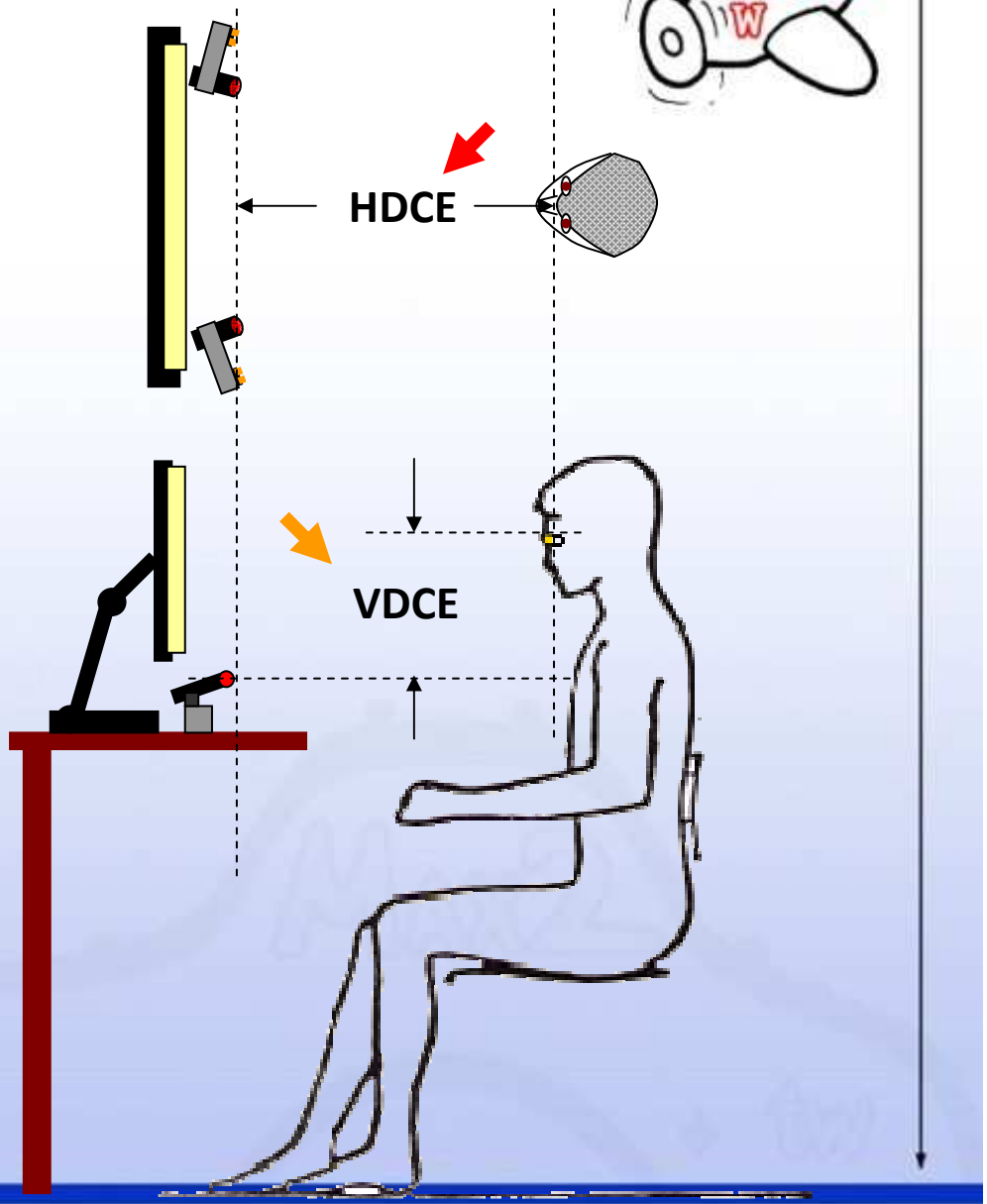
2.7 Parameters: Distance – HDCE & VDCE

Horizontal Distance from CCD to Eyes (HDCE)

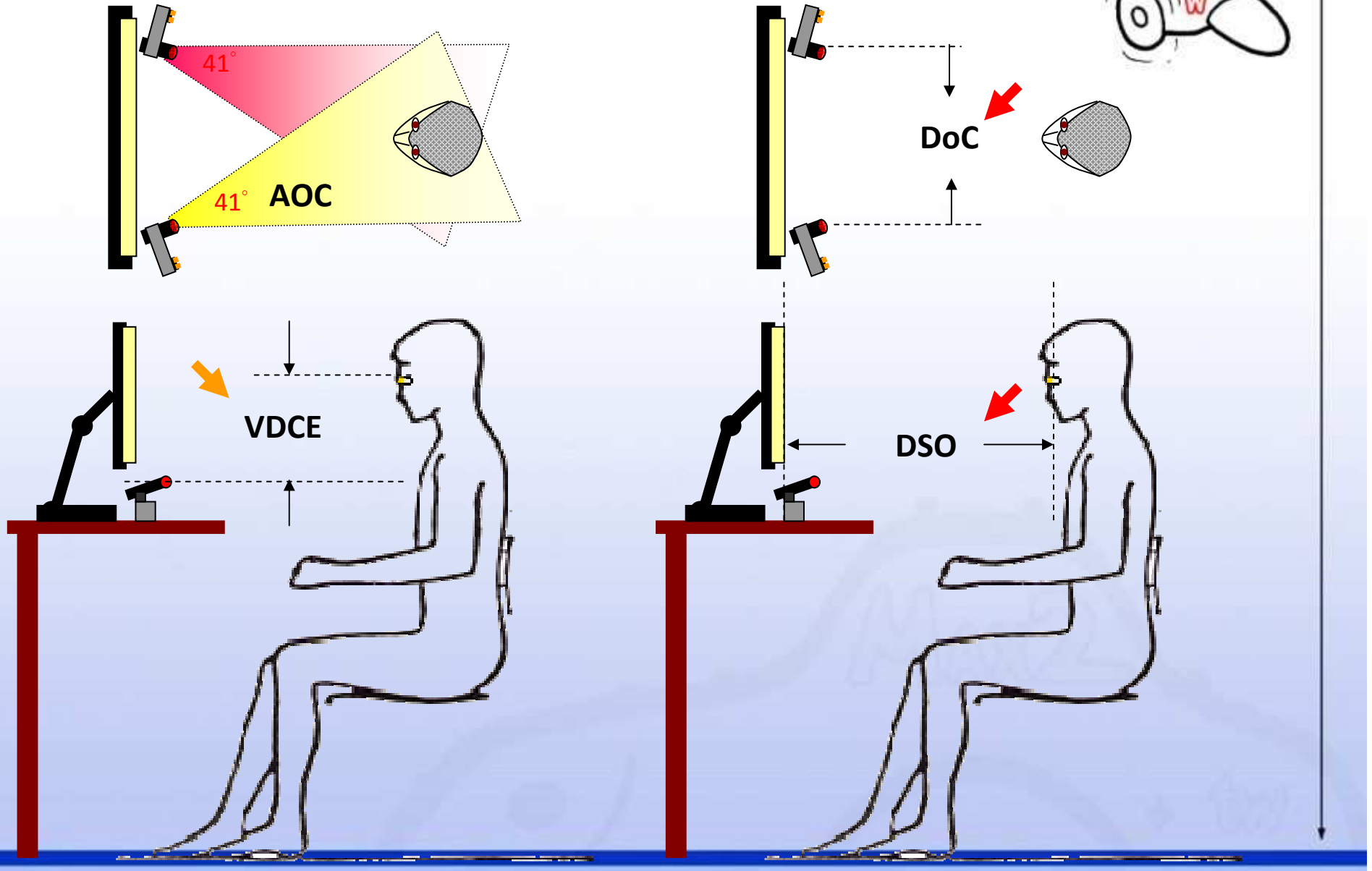
1. Subject to DSO
2. Current Setting : 75cm (29inch)

Vertical Distance from CCD to Eyes (VDCE)

1. Key Control Factor
2. Limit to: ?? cm / ??inch
3. Current Setting : 33 cm (13inch)



2.8 Summary: Key Control Factors



3. Before Implementation:

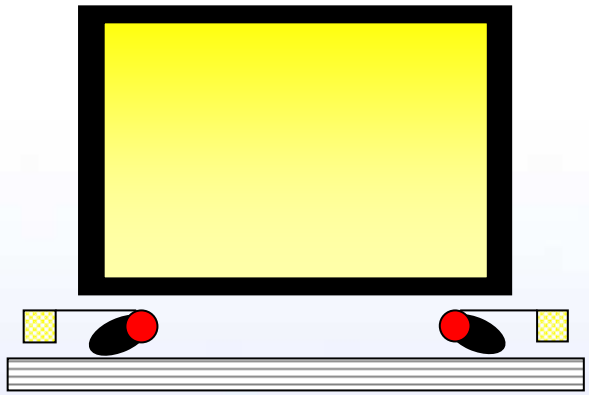
→ Screen Size ?

→ HeadBox Size?

→ Eye-Tracking Process

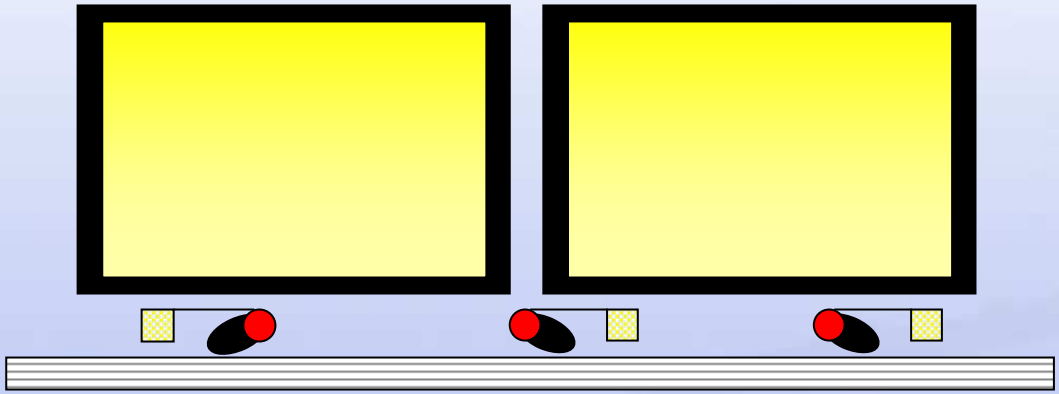
3.1 Screen Size?

According to the System Limitation, when DSO = 1m (3.3ft)



2 camera system (60°)

1. Width: 60cm (2ft)
2. Height: 60cm (2ft)

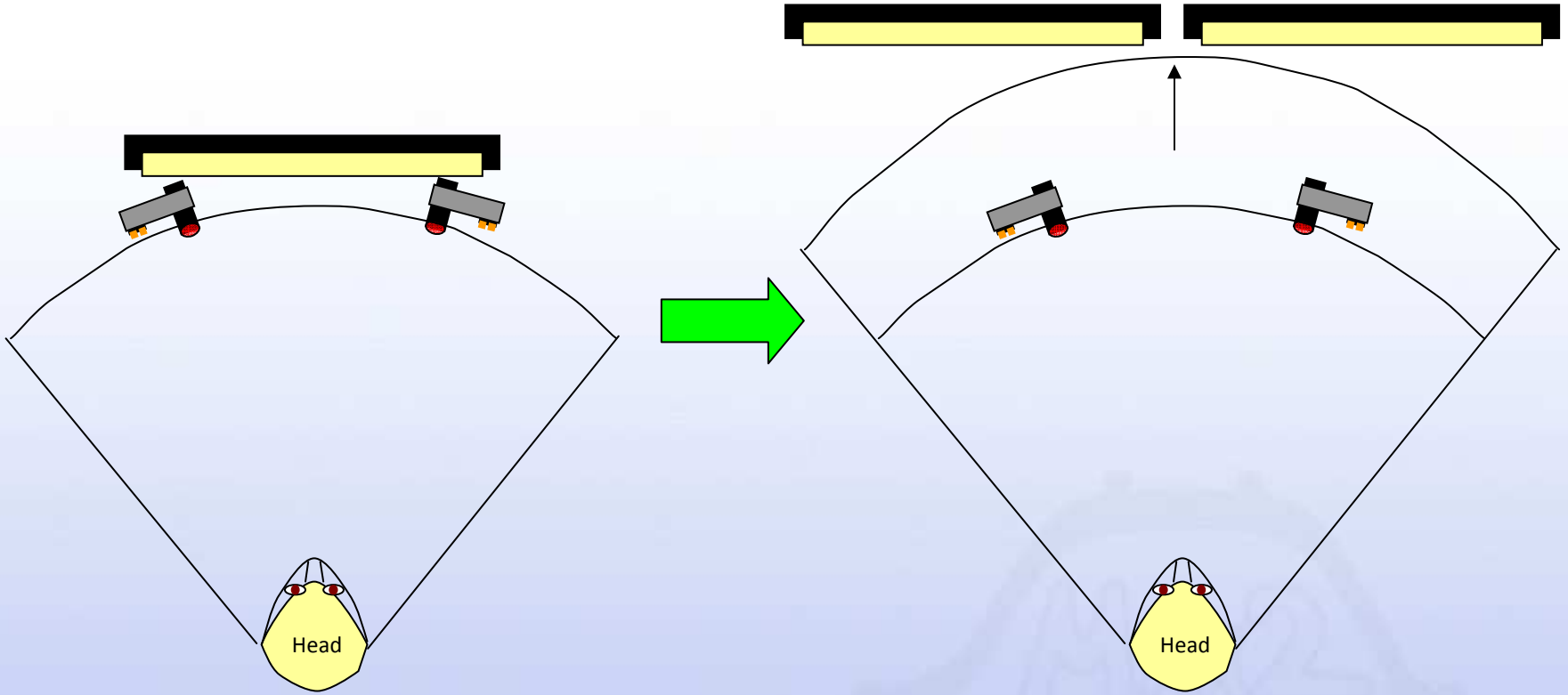


3 camera system (90°)

1. Width: 90cm (3ft)
2. Height: 60cm (2ft)

3.2 Screen Size?

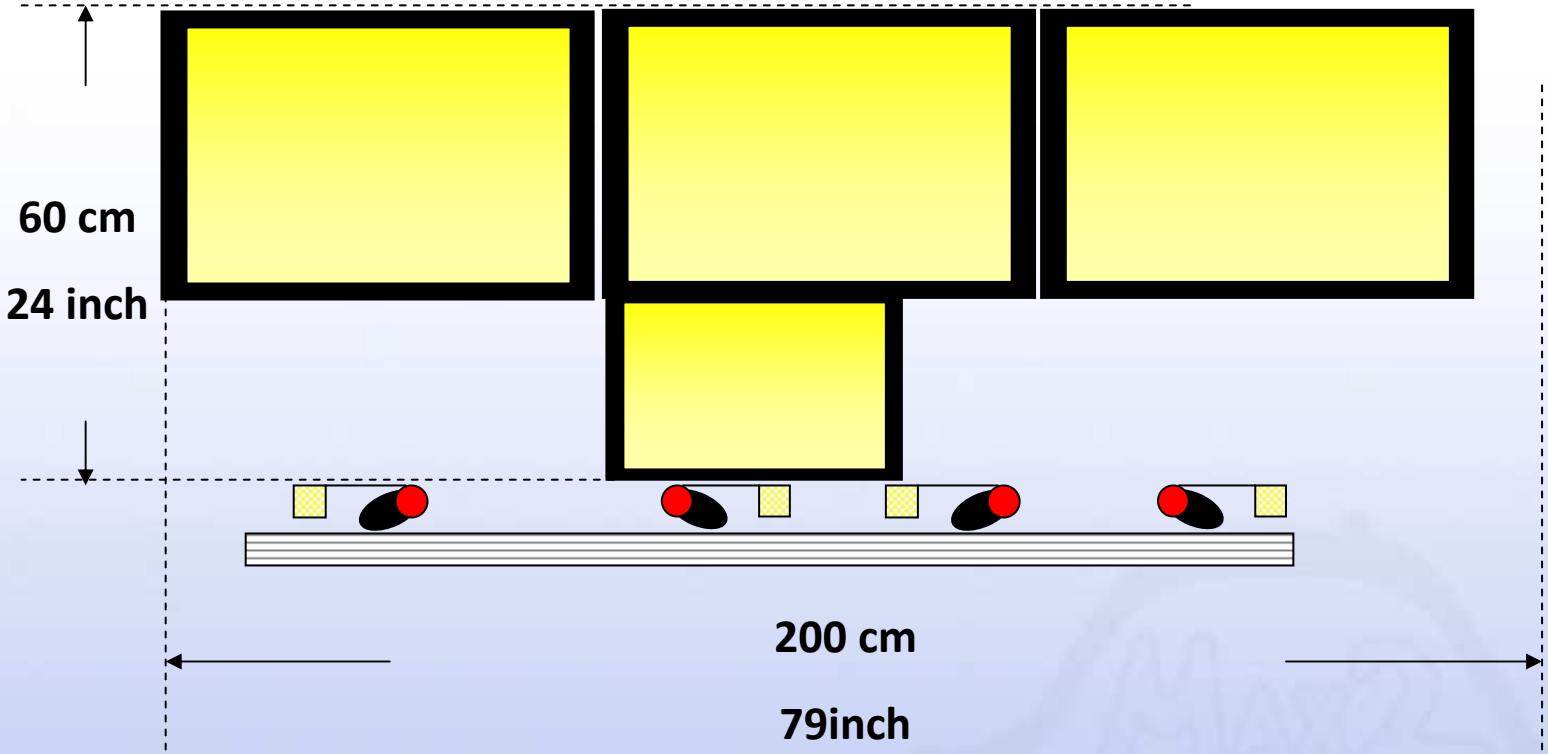
How about this (1)?



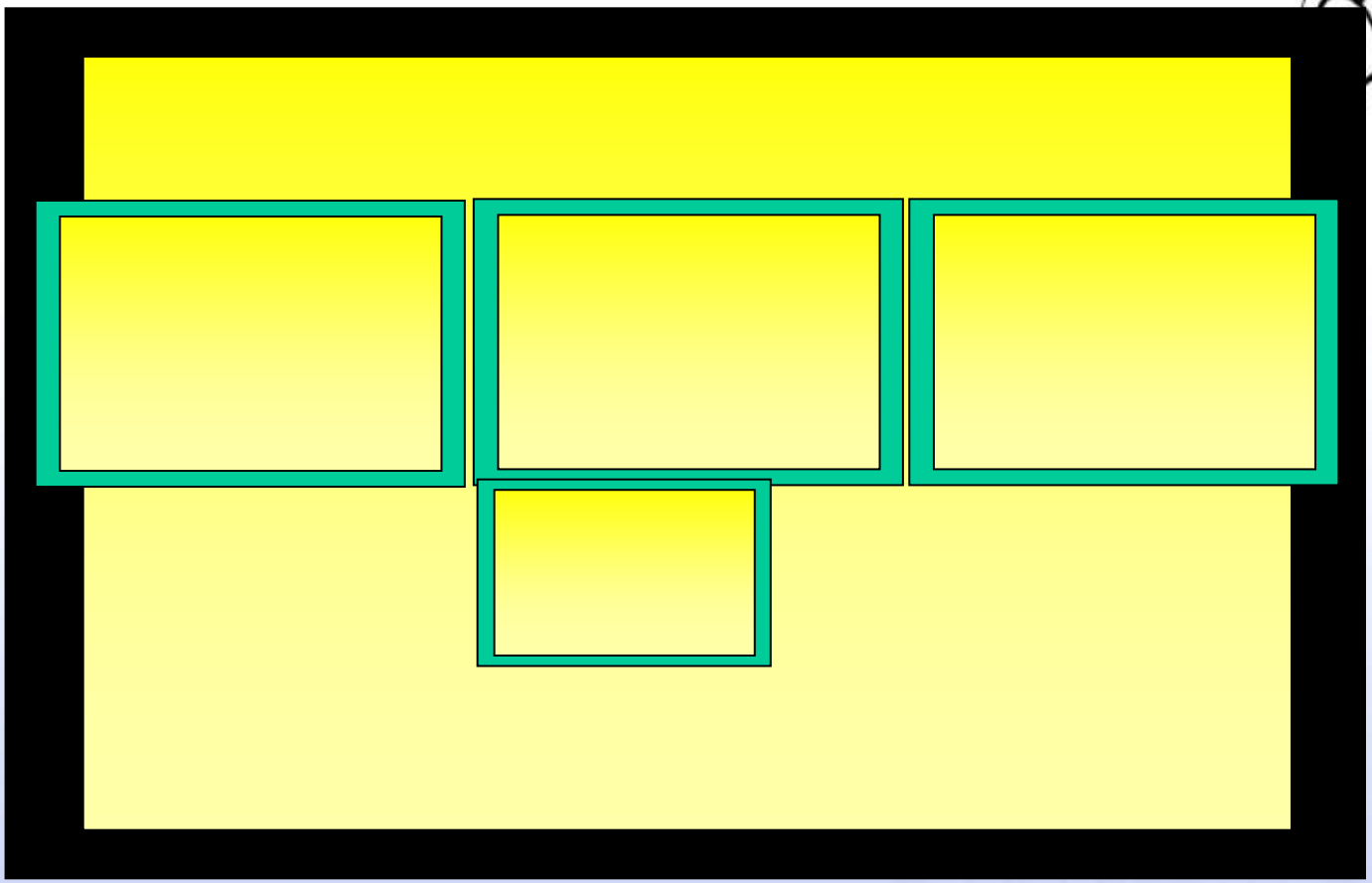
It works!

3.3 Flight Simulation Lab

For Example, in the Flight Simulation Lab

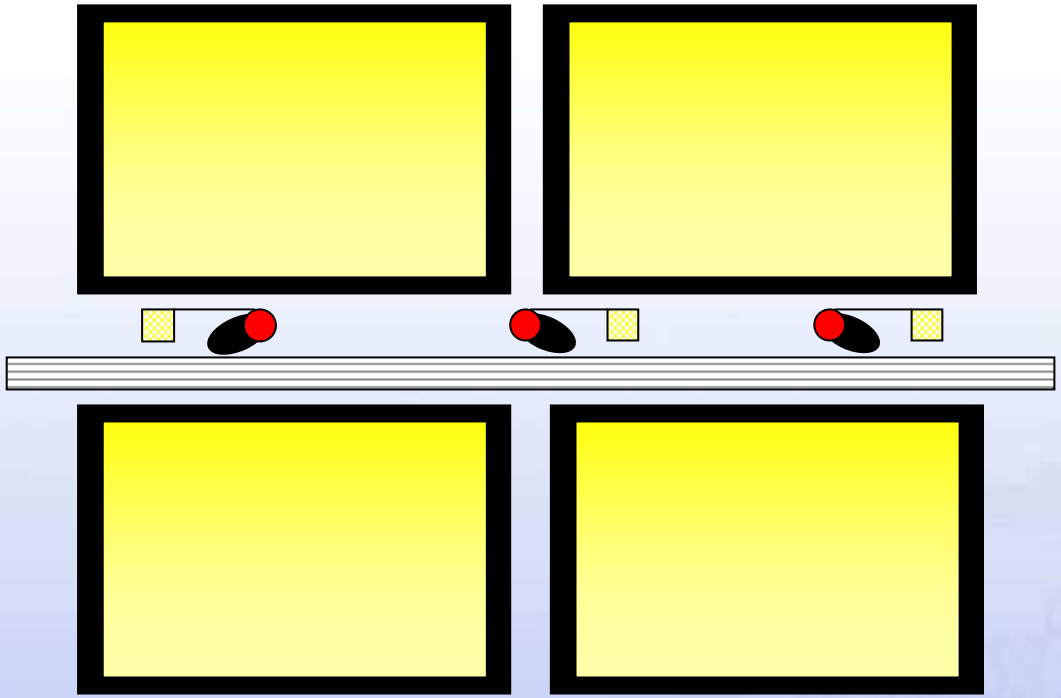


3.4 Move the Camera closer to object!



3.5 Put Screen below the Cameras?

How about this (2)?



Unknown: Need to Test!

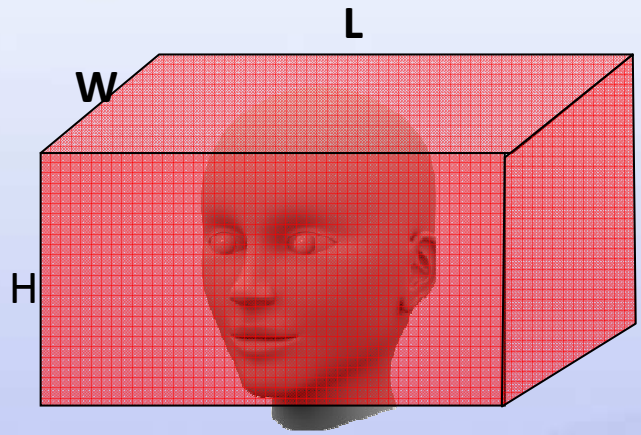
3.6 HeadBox Size?

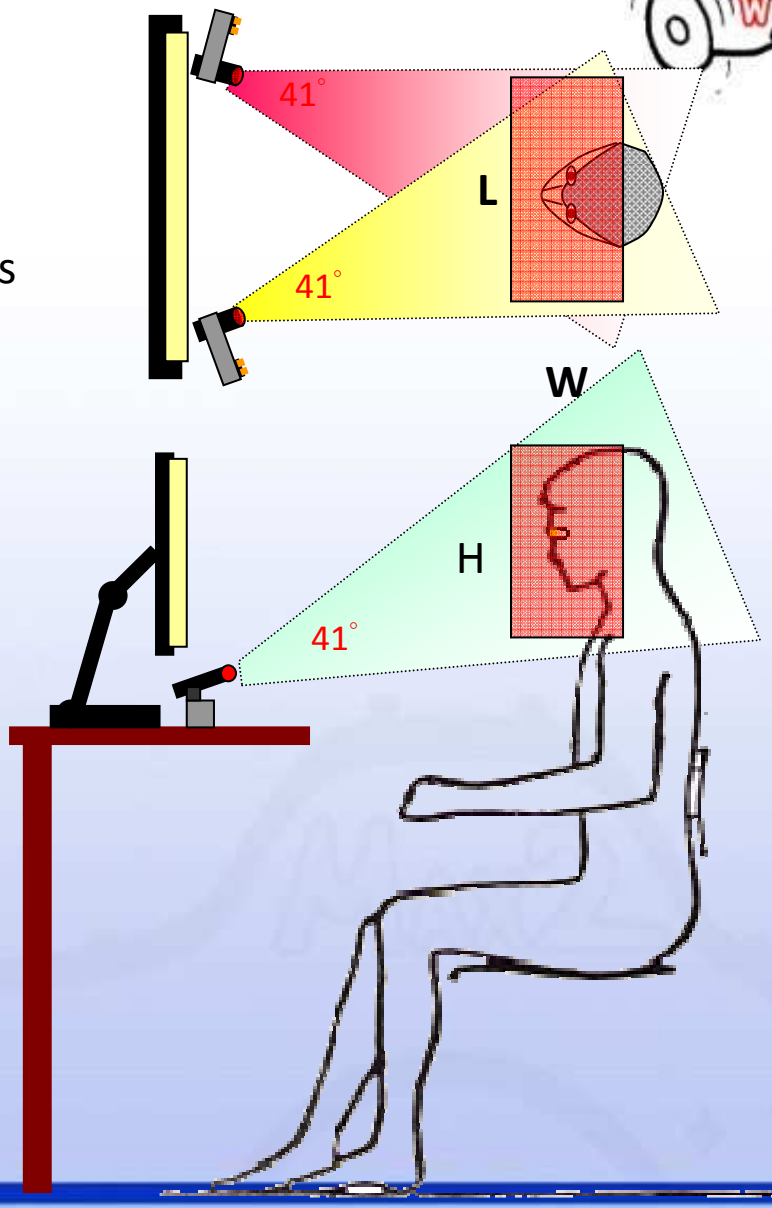
HeadBox Size

1. Subject to Lens and HDCE
2. When HDCE = 85cm, using 2 cameras

HeadBox = 48(L) x 36(W) x 36(H) cm

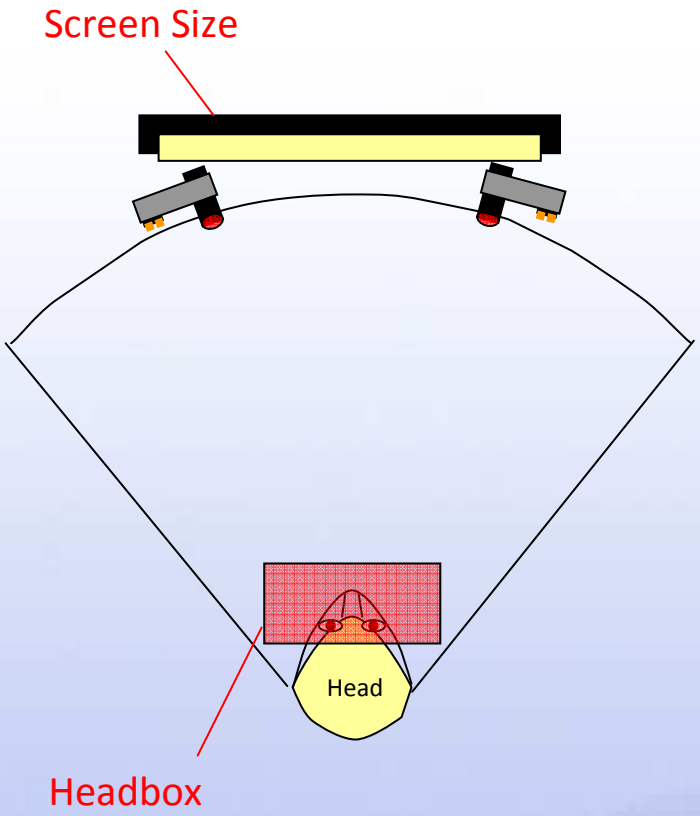
= 19(L) x 14(W) x 14(H) inch





3.7 Before we start!

2 issues need to consider



1. What is our screen size?

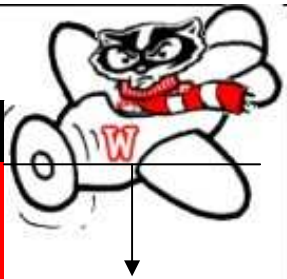
   How many Areas Of Interest do we need?

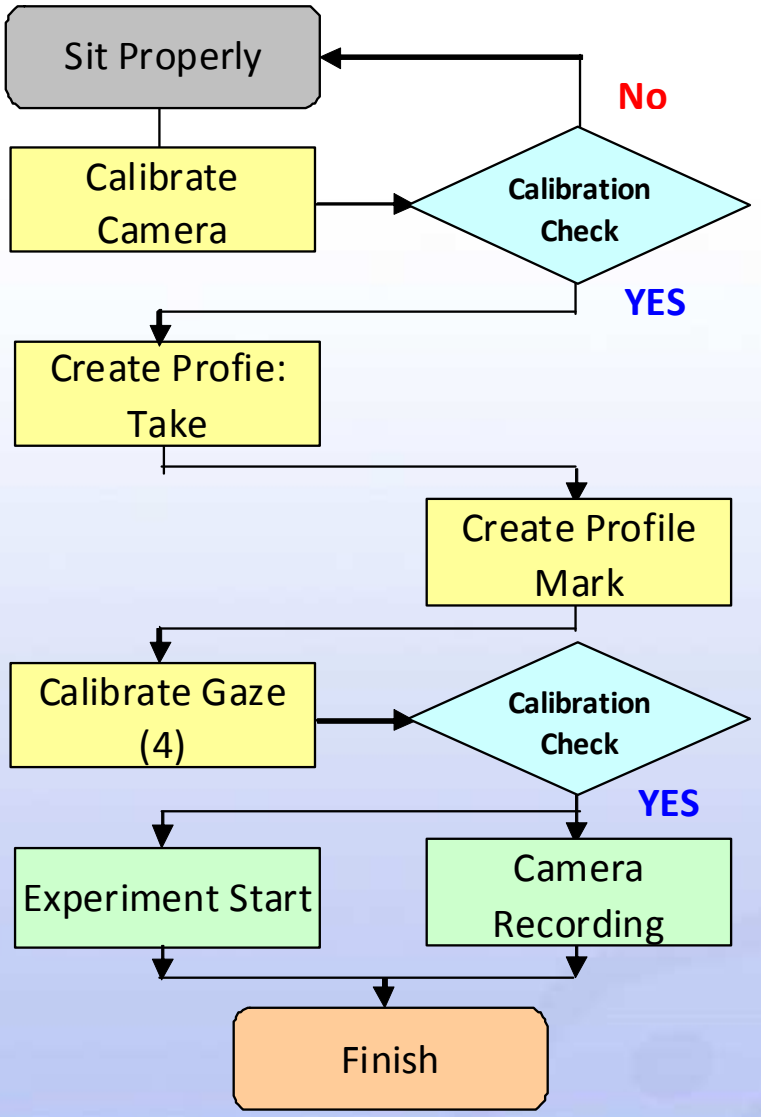
   Do these AOIs need to be watch sensitively?

2. Can the objective move his/her head?

   What is the Headbox size?

3.8 Eye Tracking Process

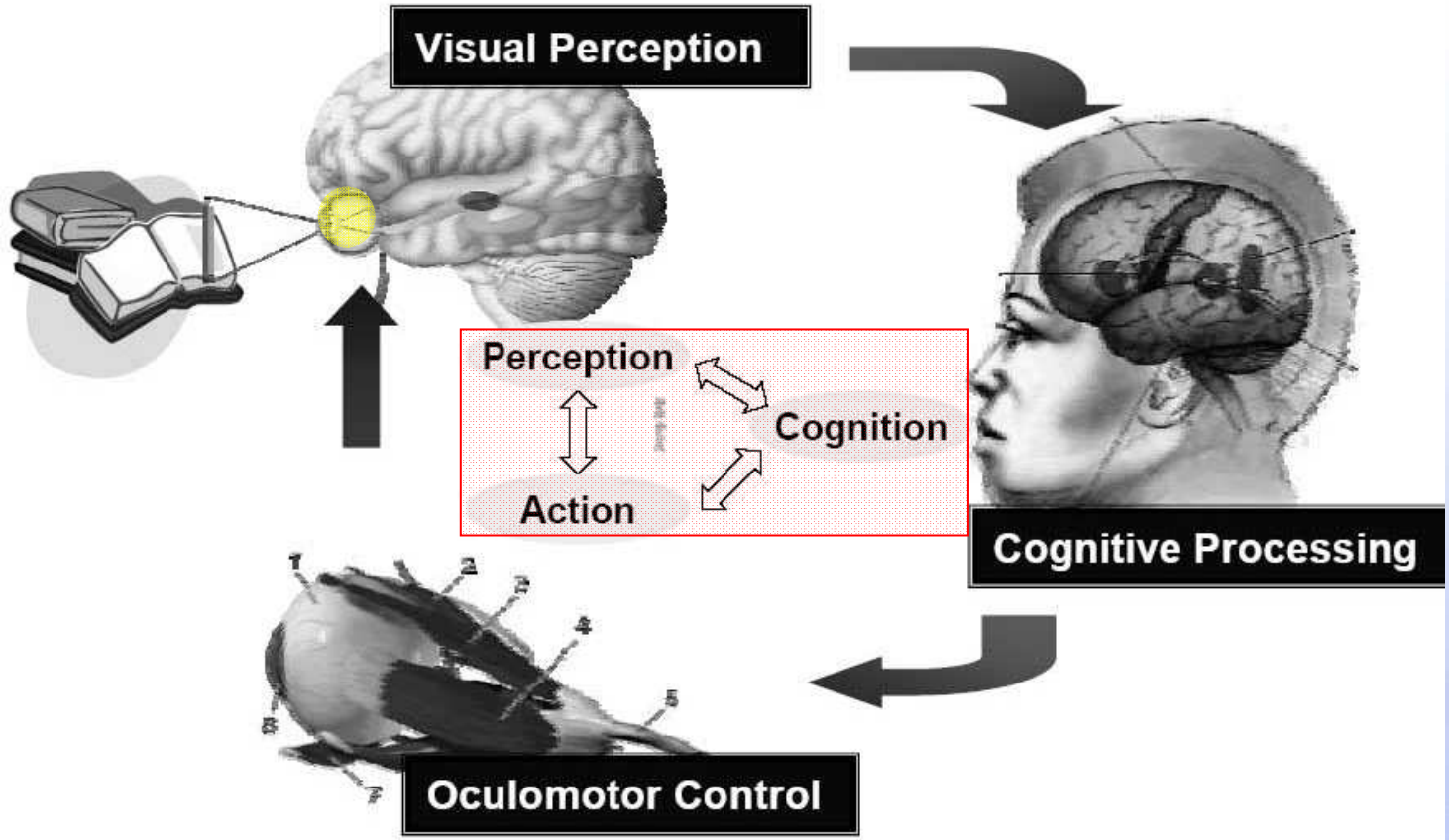


Objective	Remote Control	Note
		**A. Prepare Stage** 1.1 Takes about 0.5 min 1.2 Using the Chessboard 2.1 Takes about 1 min 2.2 Require 7 snapshots (2C + 5R) 3.1 Takes about 10 mins 3.2 Manual Remark the facial features 4.1 Takes about 1min 4.2 Require 8 calibration points **B. Experiment Stage** **C. Follow-up Action**

15min

4. Some application of Eye-Tracking in Aviation

Eyes Movement Interaction



Source: Tang(2006)

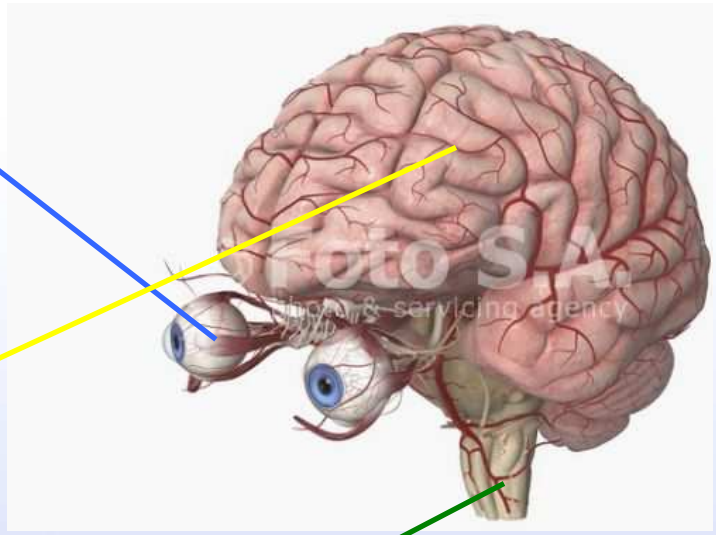
4.1 Decision-Making

Perception

Cognition

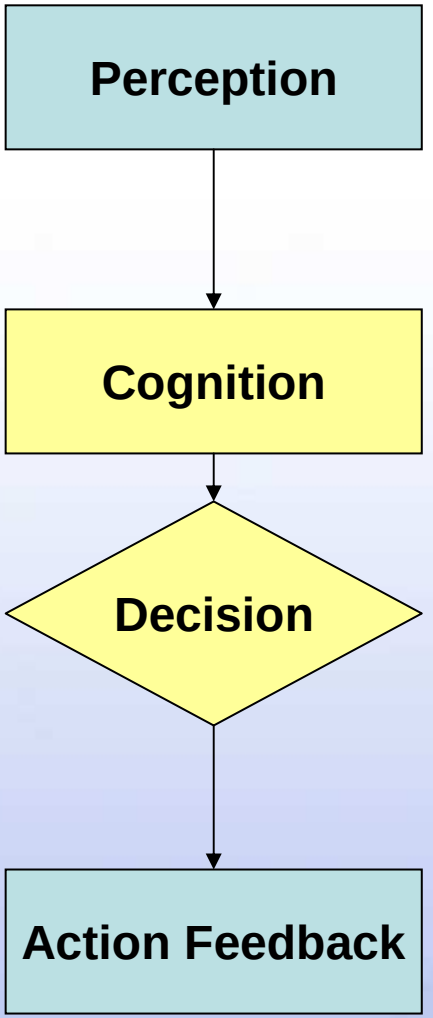
Decision

Action Feedback



Source: fotosa.ru

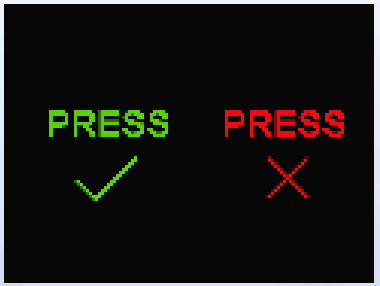
4.2 Decision-Making: Example



1. Weather Condition

2. Pilot's experiences, Training Effectiveness

3. Decide: Go / No-Go



In this case:

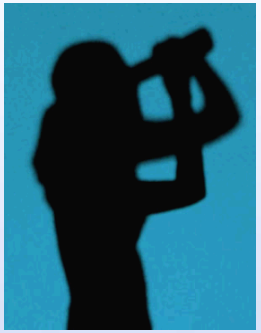
Eye Tracking is using to detect which dwelling-order will effect the decision. (Cloud -> Sky -> Terrain)

Source: Sawyer & Shappell (2009)

4.3 Comparing New & Old Human-Computer Interface

Ex: *Is a new system more effective than the old one?*

	New	Old
Alarm		



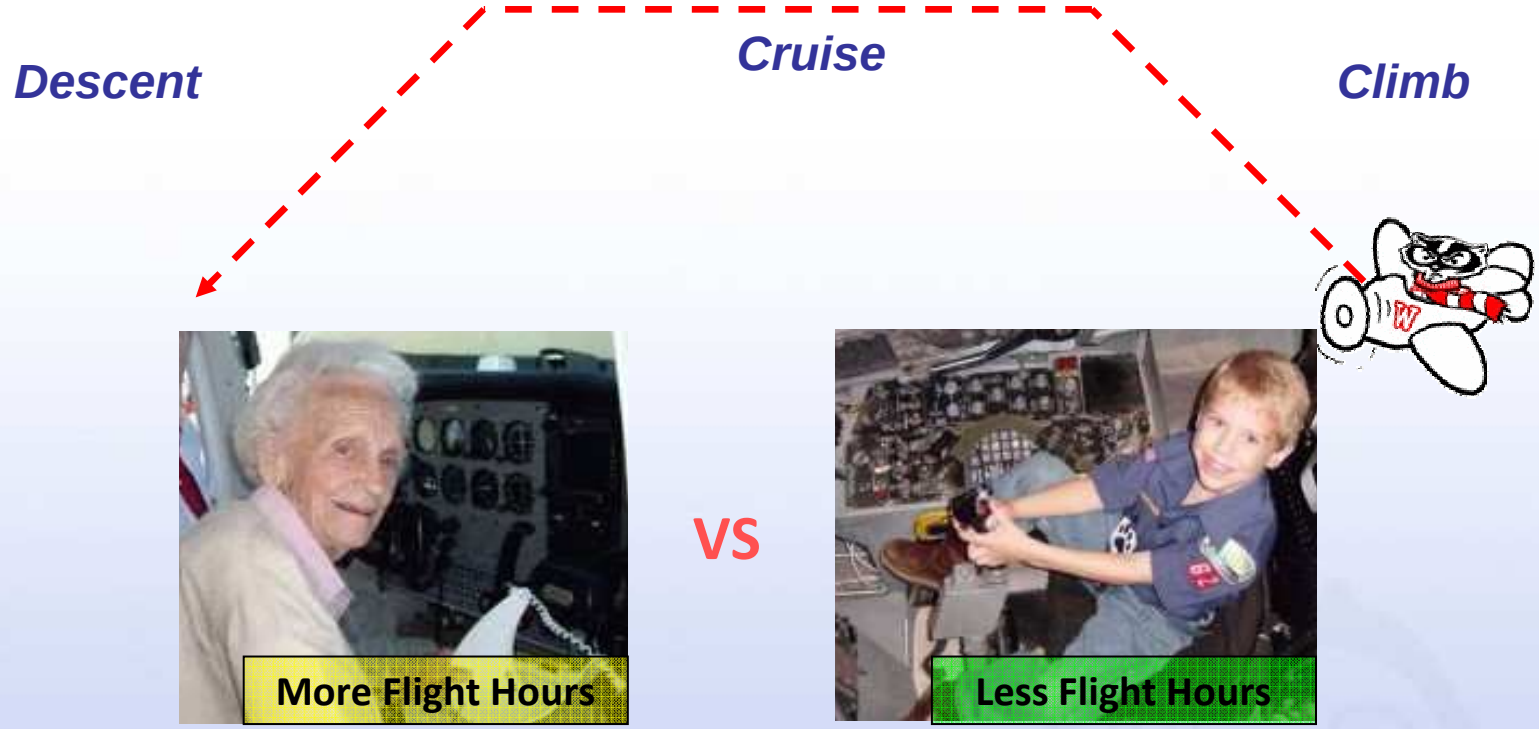
In this case:

Eye Tracking is using to collect the eyes' scanning time to compare the new & old system. The same concept can implement to evaluate a new HCI.

Source: Lavine et al (2002)

4.4 Comparing More & Less Pilots' Behavior

Ex: *As an observing tool to compare pilots' behavior -> An input to Training*



In this case:

Eye Tracking is using to collect the pilots' eye gaze sequence during these three stages, and then to compare the behavior between More & Less pilots.

Source: Sarter et al (2007)

Thank you!
Questions?

References 1 of 2

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