

Multimodal Interaction

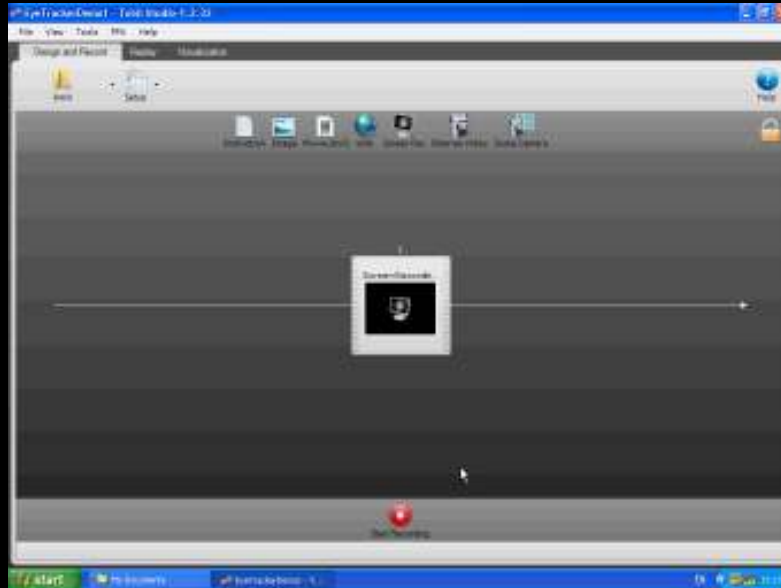
Eye Gaze and Head Movement Tracking Iris Recognition

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What is Eye Tracking & Gaze Control

- **Eye tracking** is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement.
- **Gaze control** is about effecting computer action by changing the direction of one's gaze (eye movement), blinking or dwelling on an object.

Eye movement



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How Eye Tracking Works

- Most Commonly used technique is Pupil Centre and Corneal Reflection Technique.
- Simple calibration procedure (usually following a shape around screen required for each user.
- Infrared-sensitive video takes rapid pictures of eye.
- Infrared LED illuminates the eye.
- LED reflects small amount of light off the cornea & through the pupil onto the retina.
- Bright pupil allows image processor to locate centre of pupil.
- Tracker can then locate where the person is looking on the screen based on the relative positions of the pupil centre and corneal reflection within the video image of the eye



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Types of Eye Tracker

- Non-intrusive
 - Attached to device (e.g.: Facelab)
 - Mobile (e.g.: Tobii X series)
- Intrusive
 - Glass based (e.g.: SMI Eye Glass)
 - Head attached
 - Lens based (very early models)
 - Electrodes (early models)

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Comparison

- Non-Intrusive
 - Records natural interaction
 - Have issues with ambient illumination, screen size and head movement
- Intrusive
 - Needs to wear glasses or head mounted device
 - Supports head movement
 - Works for small and big screen devices
 - Mobile phone, big display etc

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Types of Technology

- Infra red based
- Video based
- Electrode / Lens based (early models)

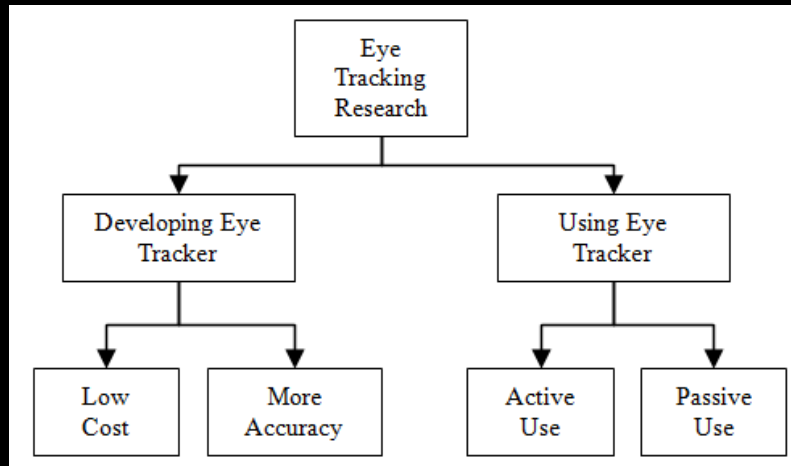
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Comparison

- Infra red based
 - Accurate
 - Needs to install infra red trackers
 - Costly
- Video based
 - Less accurate
 - Works with existing webcam
- Some video based eye trackers need special camera though it is still less costly than infra red ones
- Recent work also investigating use of low cost infrared tracker (e.g.: EyeTribe Technology, \$99 infrared ET)

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Types of Applications



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Passive Eye Tracking

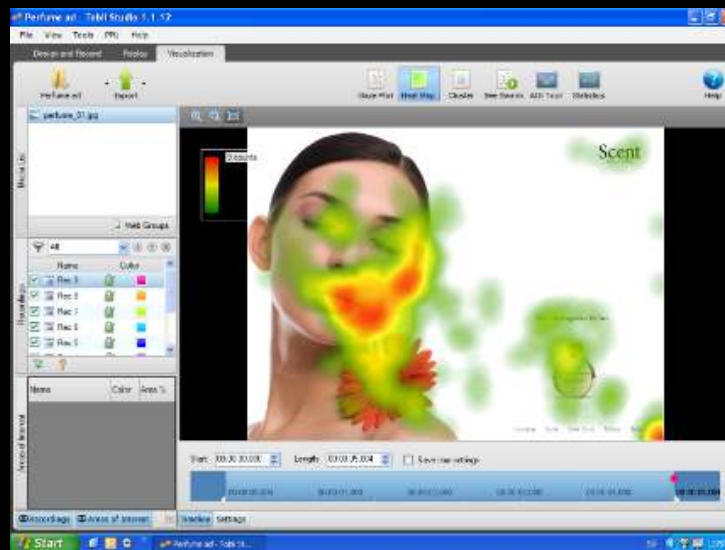
Theory of Visual Perception

Points of Fixation



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Area of interest



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Applications

- Analyzing points of fixation and eye movement to investigate
 - Areas of interest in a display
 - Reading behaviour
 - Affect state of user
 - Visual impairment
 - Nystagmus – irregular eye movement
 - Design of billboard, traffic sign etc.

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Active Eye Tracking

Gaze Control Interface

Types of Eye Gaze Movement

- Saccades
- Small Pursuits
- Vergance

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Issues with gaze control

- Strain
- Accuracy
- Selection
 - Midas Touch Problem

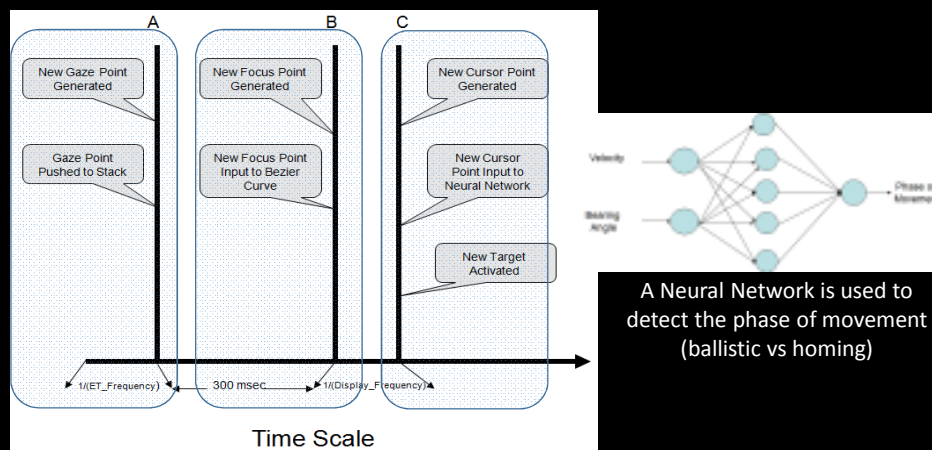
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Multimodal Eye Tracking

- MAGIC System
 - Selection using mouse
- Eye Tracking and BCI
 - Selection through imagined action detected through EEG
- Eye Tracking and Assistive Technology
 - Selection through single switch scanning

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Target Prediction for Eye Gaze Tracking System



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Iris Recognition

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Introduction

- Iris recognition is a method of biometric identification and authentication that use pattern-recognition techniques based on high resolution images of the irises of an individual's eyes .

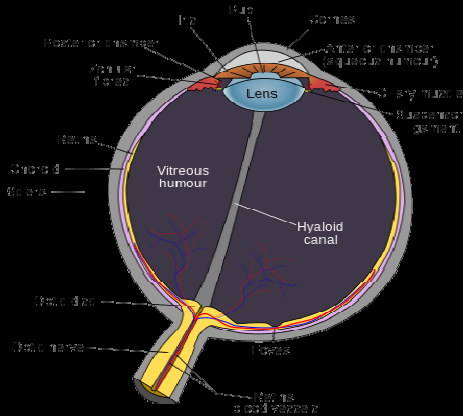


- It is considered to be the most accurate biometric technology available today.

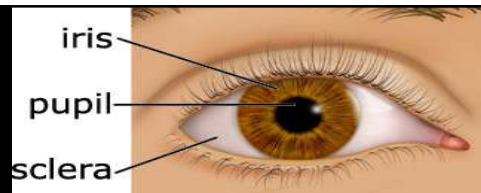
What is Iris ?



The colored ring around the pupil of the eye is called the **Iris**



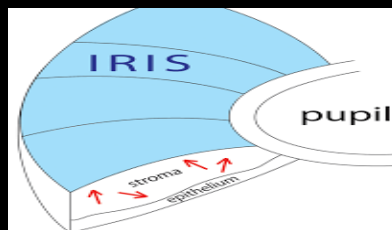
What is Iris ?



- ★ The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye.
- ★ The iris is perforated close to its centre by a circular aperture known as the pupil.
- ★ The function of the iris is to control the amount of light entering through the pupil.
- ★ The average diameter of the iris is 12 mm, and the pupil size can vary from 10% to 80% of the iris diameter

What is Iris ?

- The iris consists of a number of layers, the lowest is the **epithelium layer**, which contains dense pigmentation cells. The **stromal layer** lies above the epithelium layer, and contains blood vessels, pigment cells and the two iris muscles.



What is Iris ?

- ❖ The density of stromal pigmentation determines the colour of the iris.
- ❖ The externally visible surface of the multi-layered iris contains two zones, which often differ in colour. An outer ciliary zone and an inner pupillary zone, and these two zones are divided by the collarette – which appears as a zigzag pattern



Why the Iris?

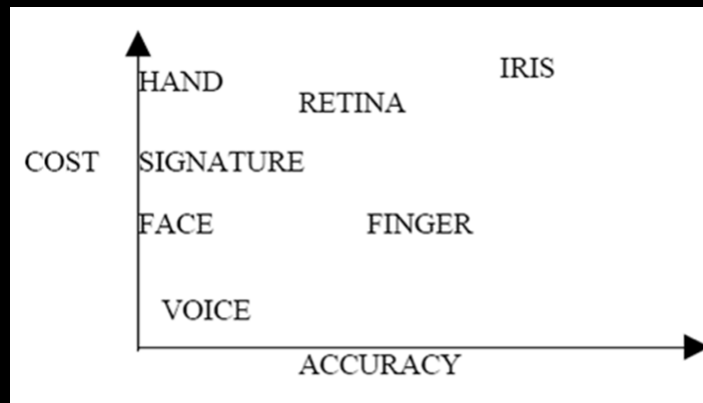


- ✓ Externally visible highly protected internal organ.
- ✓ Unique patterns.
- ✓ Not genetically connected unlike eye color.
- ✓ Stable with age.
- ✓ Impossible to alter surgically.
- ✓ Living Password, Can not be forgotten or copied.
- ✓ Works on blind person.
- ✓ User needs not to touch appliances.
- ✓ Accurate , faster , and supports large data base.

Why the Iris?

Method	Coded Pattern	MisIdentification rate	Security	Applications
Iris	Iris pattern	1/1,200,000	High	high-security
Fingerprint	fingerprints	1/1,000	Medium	Universal
voice	Voice characteristics	1/30	Low	Telephone service
Signature	Shape of letters, writing Order, pen pressure	1/100	Low	Low-security
Face	Outline, shape & distribution of eyes, nose	1/100	Low	Low-security
Palm	size, length, & thickness hands	1/700	Low	Low-security

Why the Iris?



Comparison between cost and accuracy

History of Iris Recognition

❖ The concept of Iris Recognition was first proposed by Dr. Frank Burch in 1939.

❖ It was first implemented in 1990 when Dr. John Daugman created the algorithms for it.

❖ These algorithms employ methods of pattern recognition and some mathematical calculations for iris recognition.



Methods Of IRIS Recognition System

❖ In identifying one's iris, there are 2 methods for its recognition and are:

1. Active
2. Passive

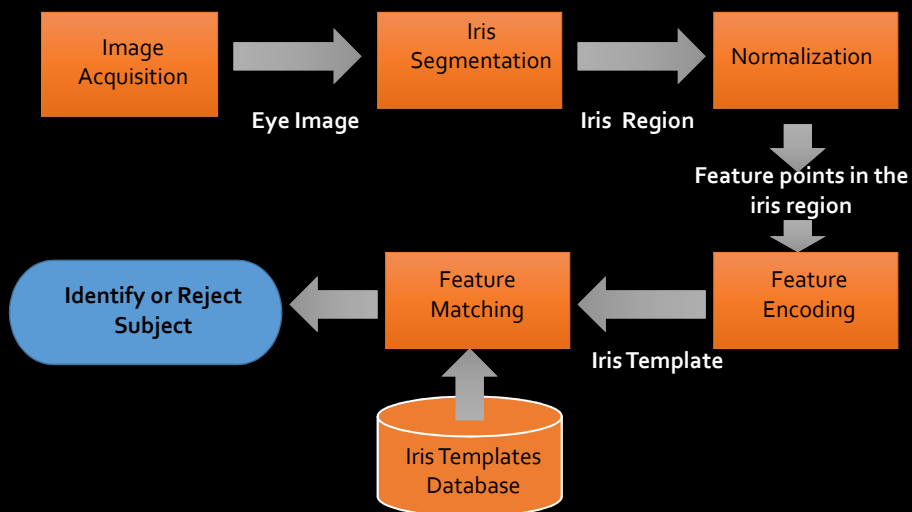


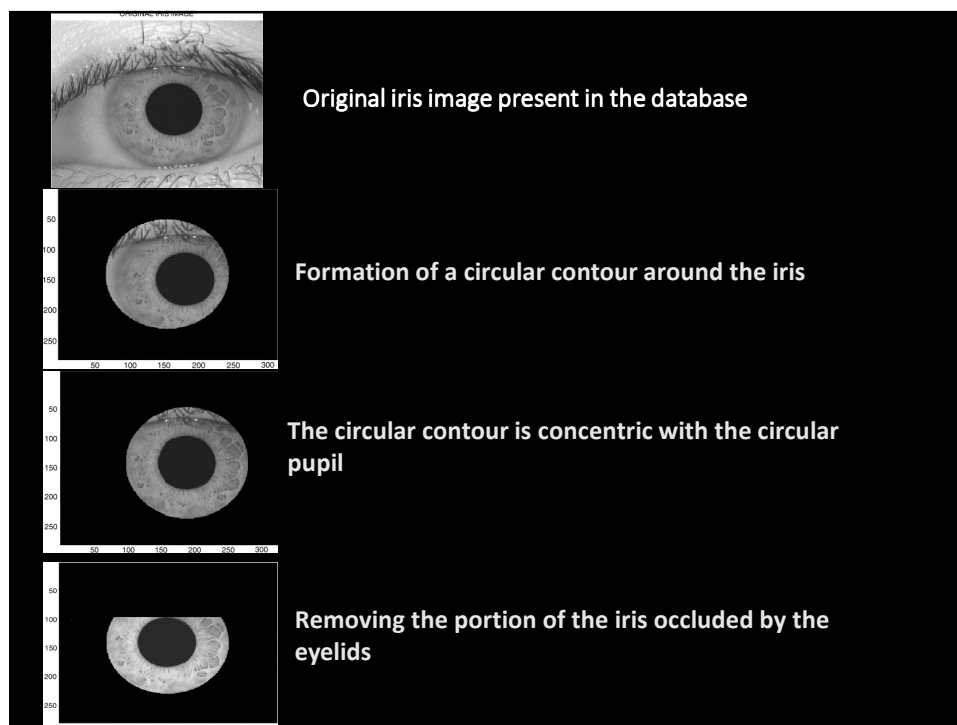
❖ The active Iris system requires that a user be anywhere from six to fourteen inches away from the camera.

❖ The passive system allows the user to be anywhere from one to three feet away from the camera that locates the focus on the iris.



Iris Recognition Diagram





Applications

- ATMs
- Computer login: The iris as a living password.
- National Border Controls
- Driving licenses and other personal certificates.
- Benefits authentication.
- Birth certificates, tracking missing.
- Credit-card authentication.
- Anti-terrorism (e.g.:— suspect Screening at airports)
- Secure financial transaction (e-commerce, banking).
- Internet security, control of access to privileged information.

Head Tracker

Related technology to gaze control

Types of Head tracker

- Helmet Based
- Video based
 - <http://www.cameramouse.com>
- Attaching Gyroscopic Tracker
- Similar issues with intrusive and non-intrusive head trackers as with gaze control

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Take away points

- Description to a new modality of interaction
- Different types of eye trackers and their comparison
- Introduction to Iris recognition technology
- Demonstration of applications of eye tracker
- Introduction to head tracking

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