

SMART CONTACT LENS

AR & VR



"Everyone takes the limits of his own vision for the limits of the world."

-Arthur Schopenhauer

AR & VR Enabled
Smart Contact Lens.

Our Mission: Augment limits of the world by augmenting what we see!

Our Goal: Develop unique, futuristic and revolutionary technology of AR & VR enabled smart contact lens system (SCL) with an embedded display. SCL plugs into the sense of sight to deliver information in an enabling and enriching fashion. We believe, such smart contact lens system has the potential to become the major AR & VR platform and eventually, in the long run, completely replace most of smart devices such as smart phones, iPads, Oculus and HoloLens, MagicLeap sets, while becoming the main means of executing AR or VR applications...

In Popular Culture

"The Terminator"

Year 1991

AR – Very si-fi, fantasy and very futuristic.



"Mission Impossible"

Year 1996

AR SCL– Very si-fi, fantasy and very futuristic.



2021-2025

Actual Implementation of AR / VR SCL.

Major Players in the field:

MOJO Vision

GOOGLE

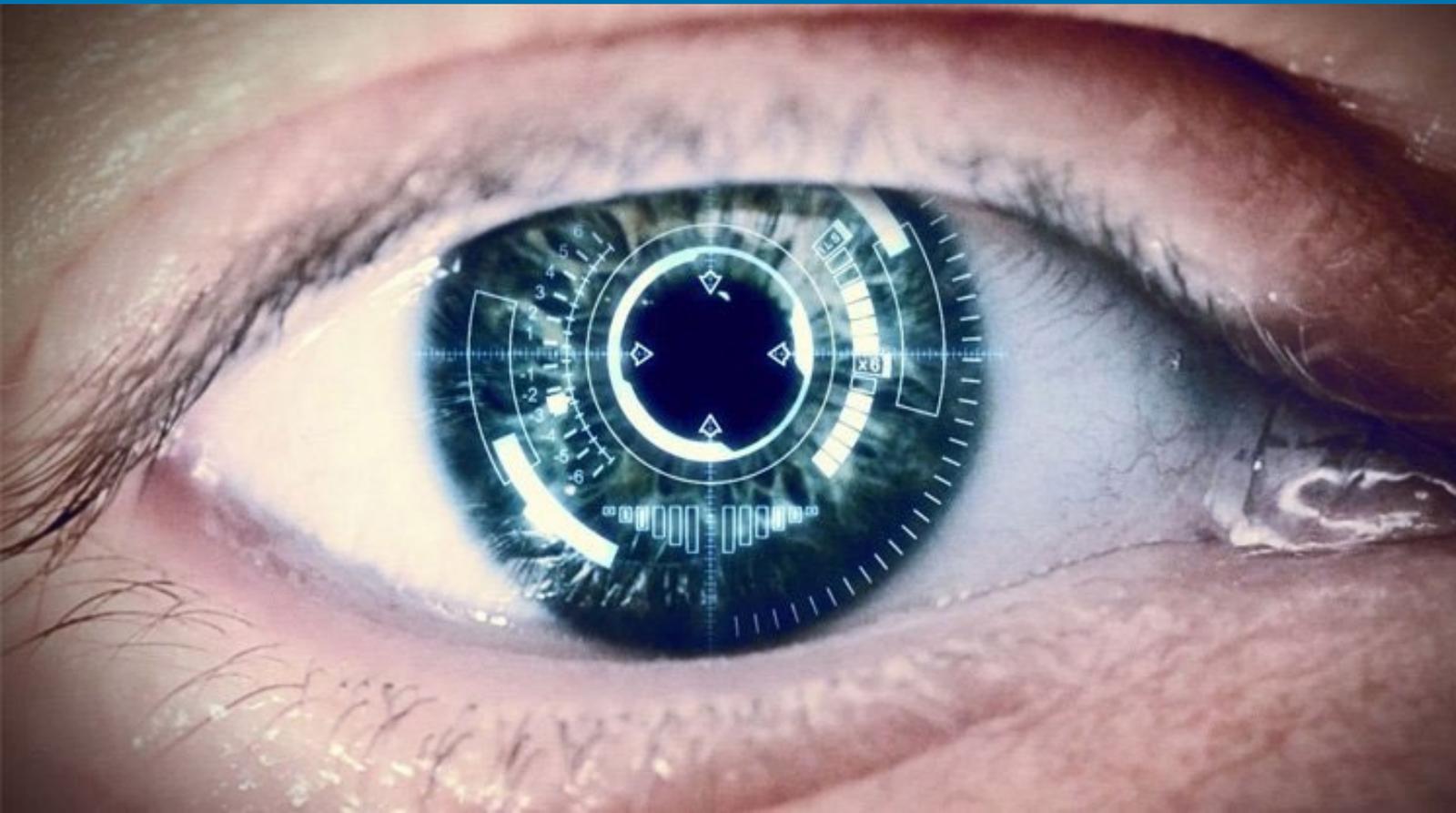
RAAYONNOVA/SCL

SAMSUNG

SONY

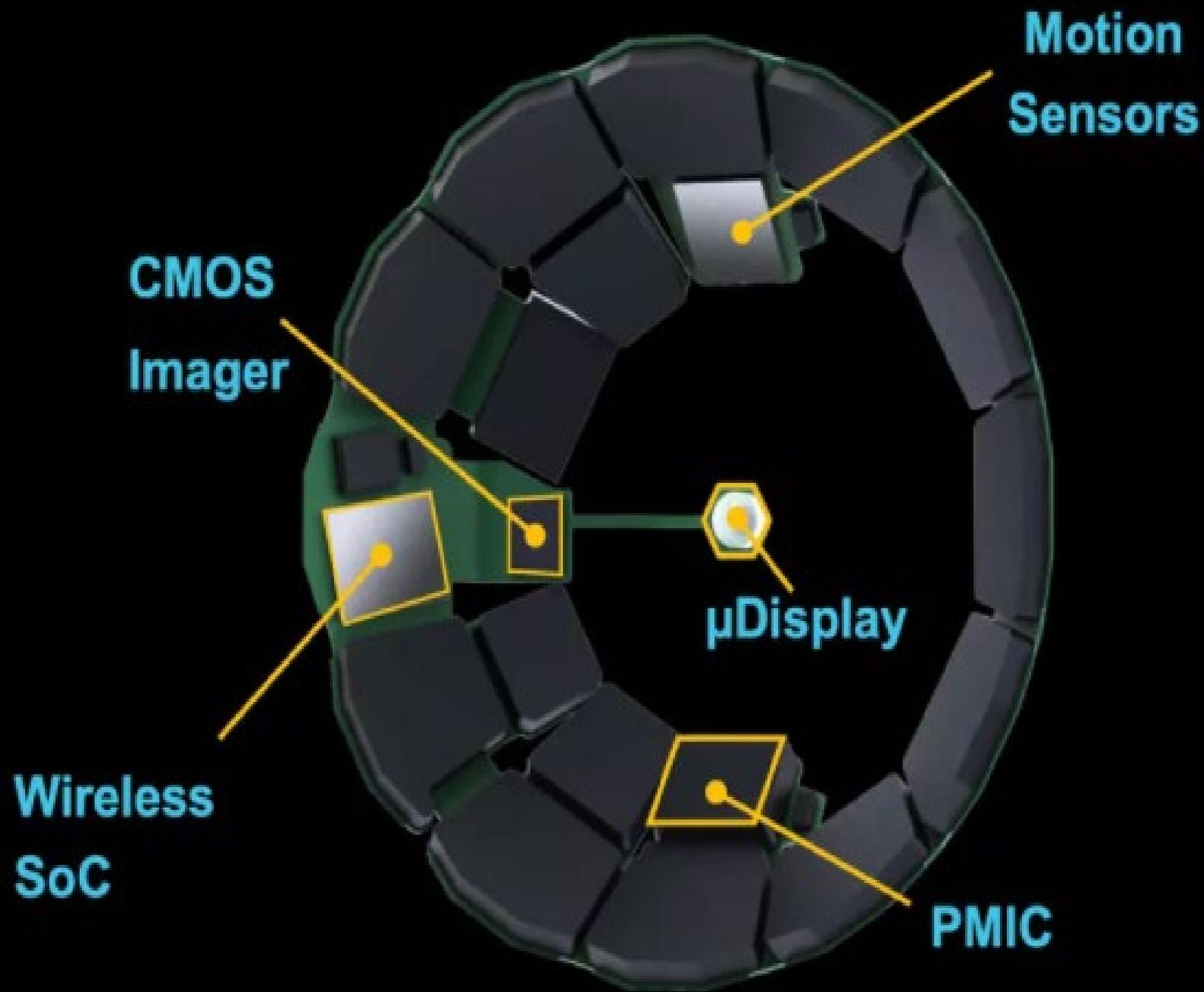
J&J Vision

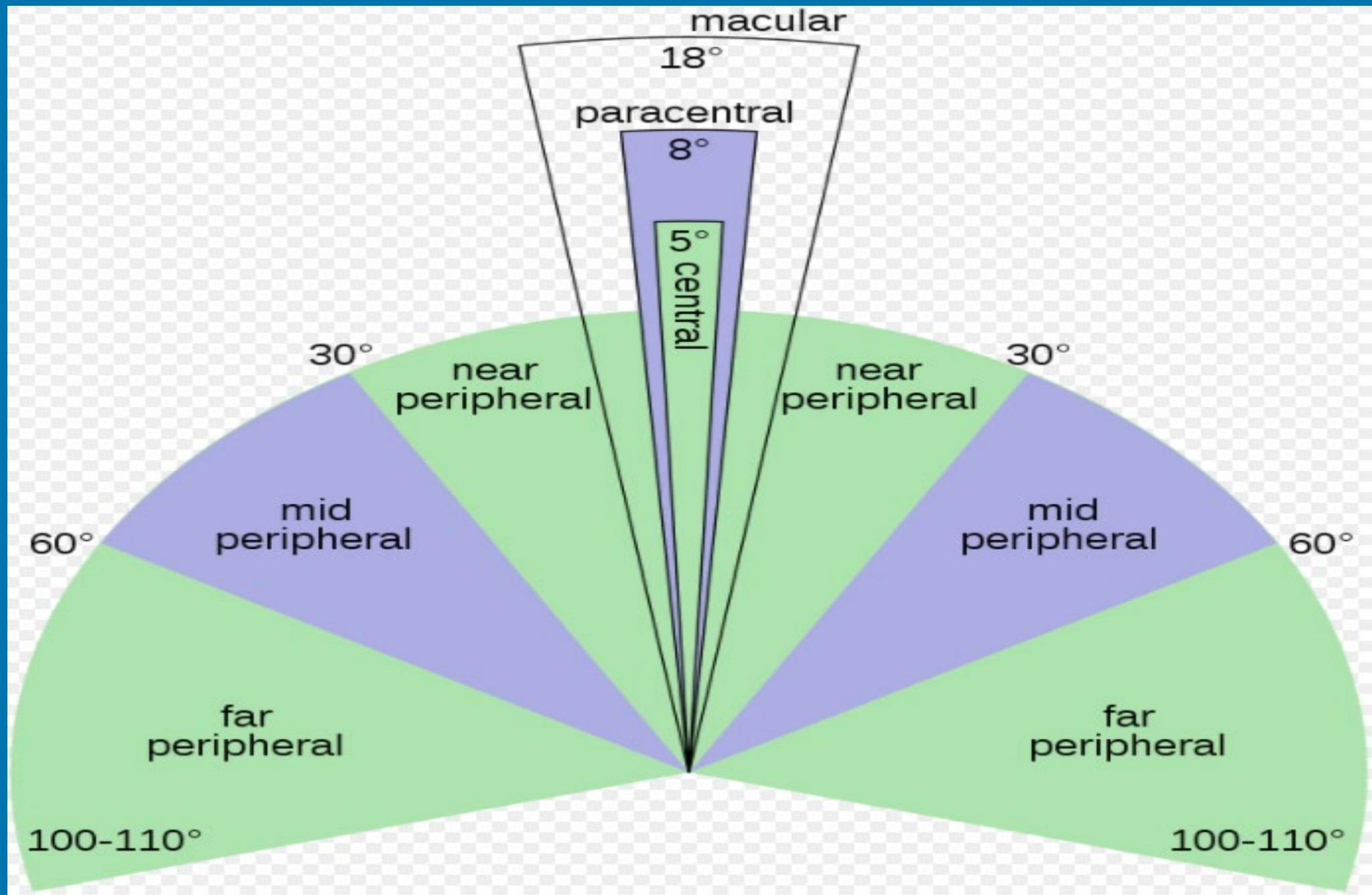
Sensimed SA



“Features Required/Desired”

- i. **Embedded Display**
- ii. **Display in Focus**
- iii. **Image In Focus – support of Refocus of different parts of an image.**
- iv. **SCL Control System**
- v. **Embedded Image Capture Or Depth Sensor device.**
- vi. **Oxygen Permeability.**

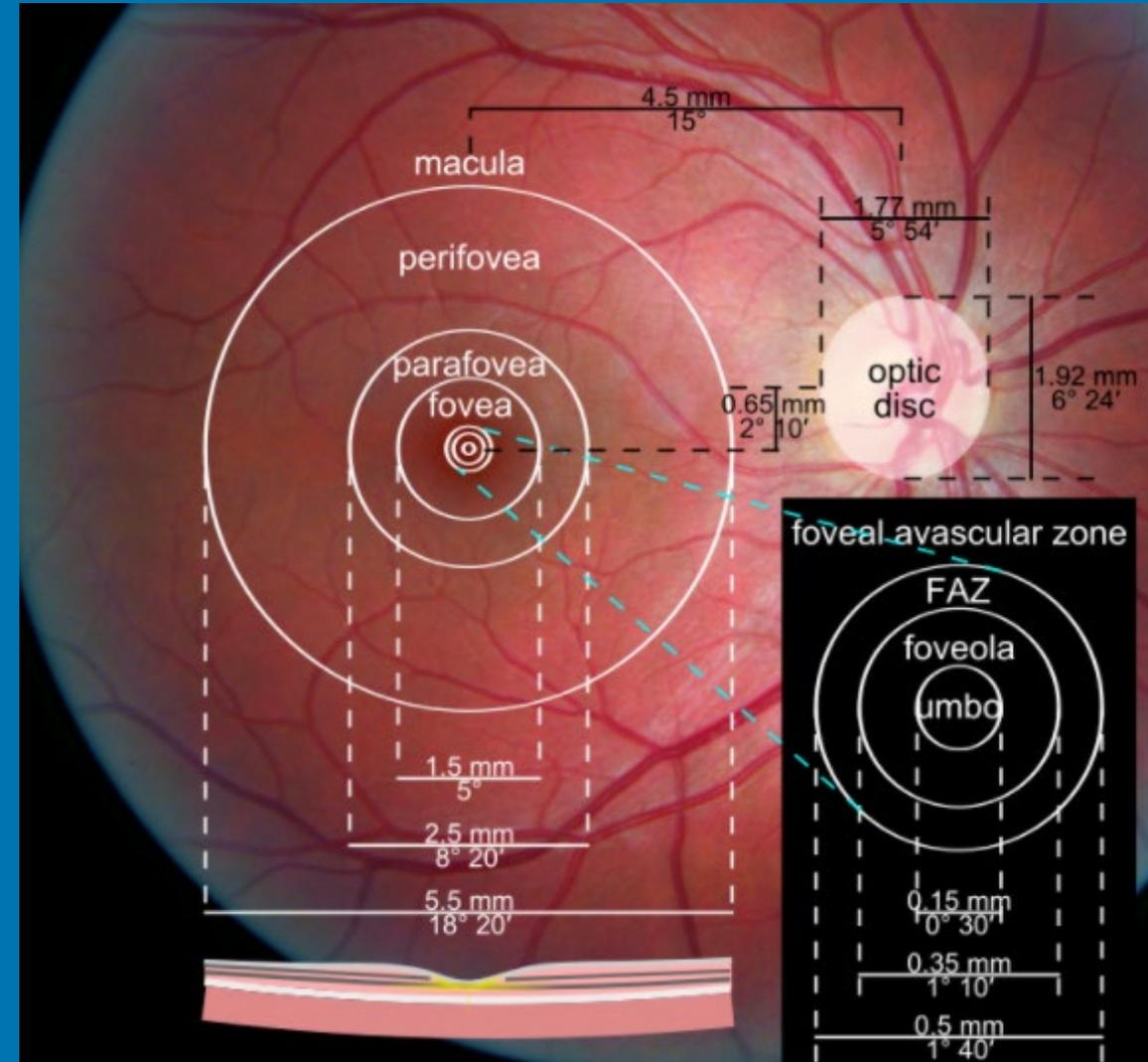




PERIPHERAL VIEW & REFOCUS.

❖ Field Of View:

- Focused Vision - Foveal area of retina. Around 2 degrees of visual angle in humans. Parafoveal – up to 6 degrees of visual angle
- Peripheral Vision - corresponds to perifoveal area of retina.



SACCADE - a rapid movement of the eye between fixation points.

The light reflected from an object or an image entering eye under direct angle will be hitting Foveal area of retina and therefore will be seen in focus.

Naturally, an eye is responsible for bringing parts of an image into focus.



❖ The image superimposed on embedded display *a priori* does not move and contact lens with the display are locked into stationary position relative to the eye, thus, no amount of eye movement will accommodate the refocus on another part of the image. Therefore, we propound to shift responsibility of bringing parts of an image overlaid into focus from the eyes to the display.

❖ Thus, different parts of an image, that are of interest to the user, will come into the focus on the need to focus basis, thereby rendering imagery superimposed onto the embedded display naturally usable and ingestible.

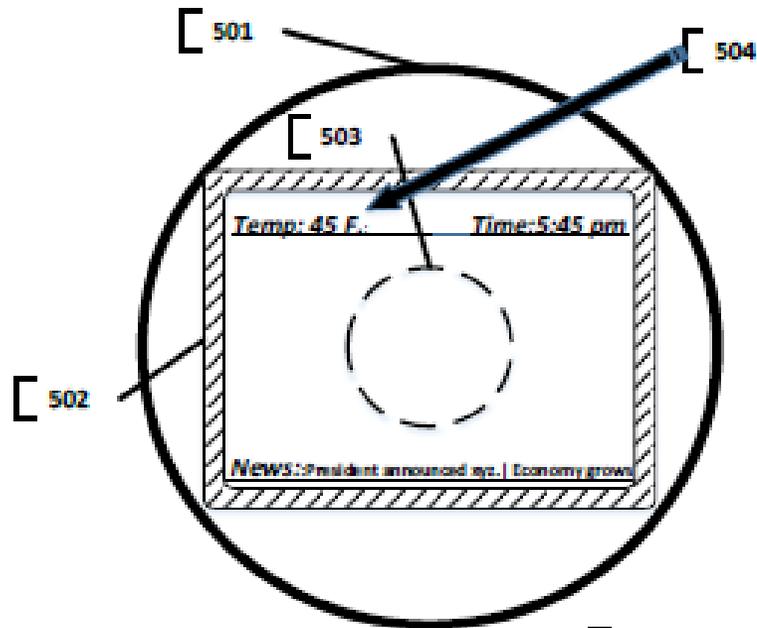


Fig 6

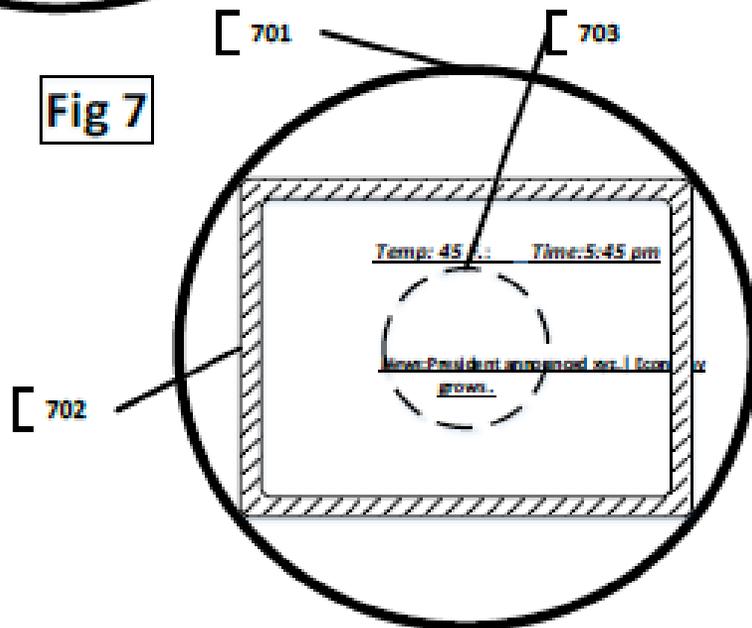
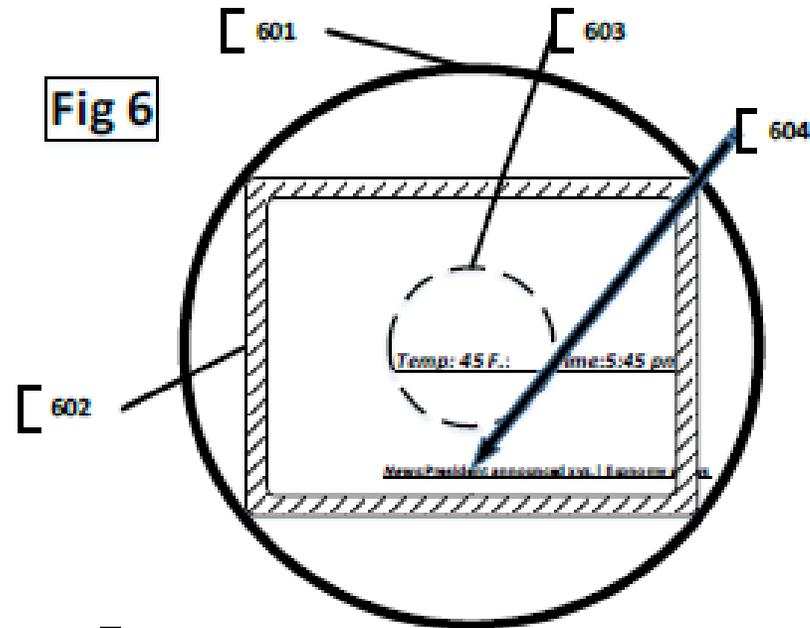


Fig 7

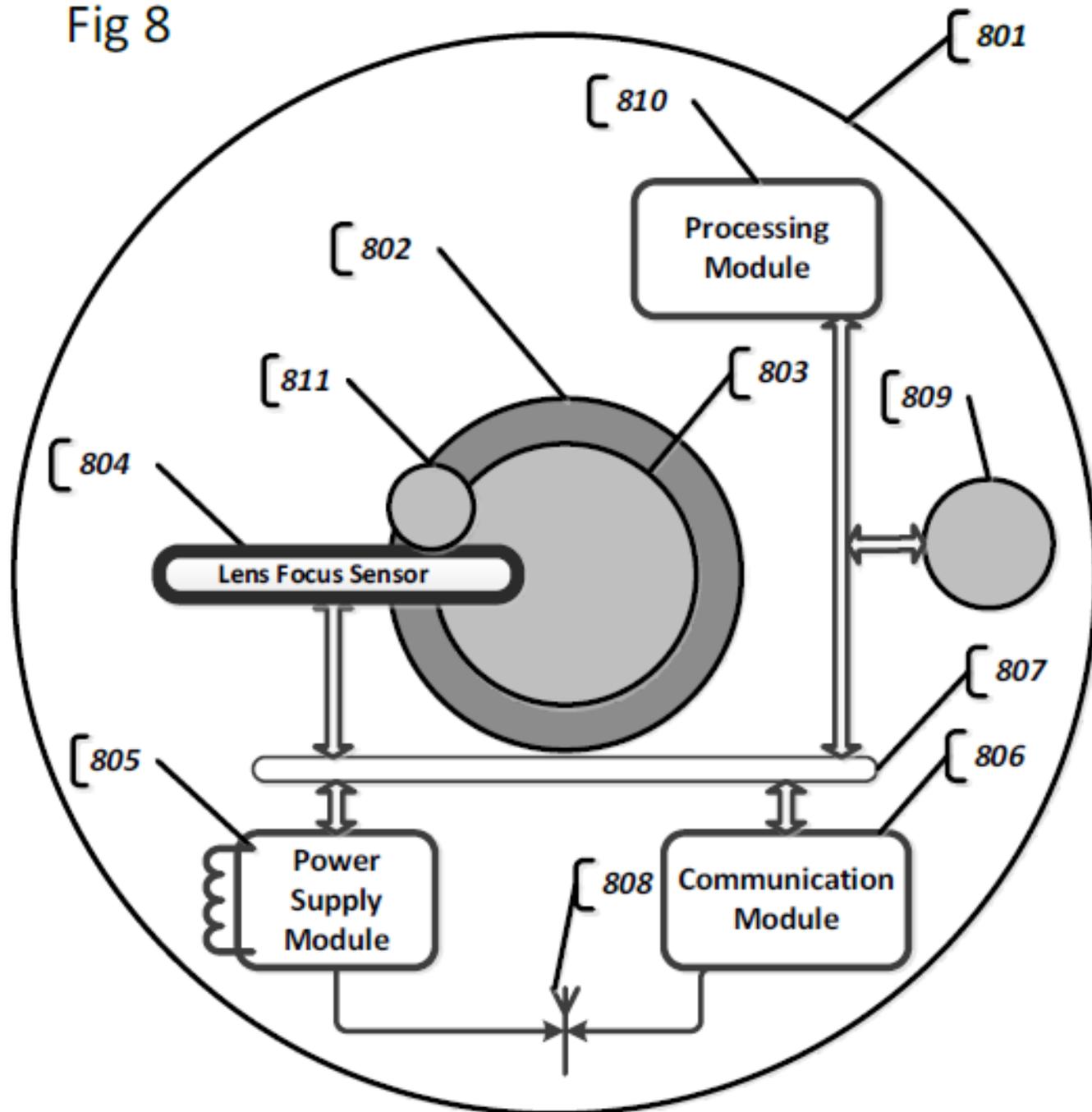
❖ Shift responsibility of bringing an image into focus from the eye to the embedded display.

Focus on various parts of an image superimposed in 2D or 3D Frame Of Reference.

❖ Image shifts in response to attempted accommodation of the eye.

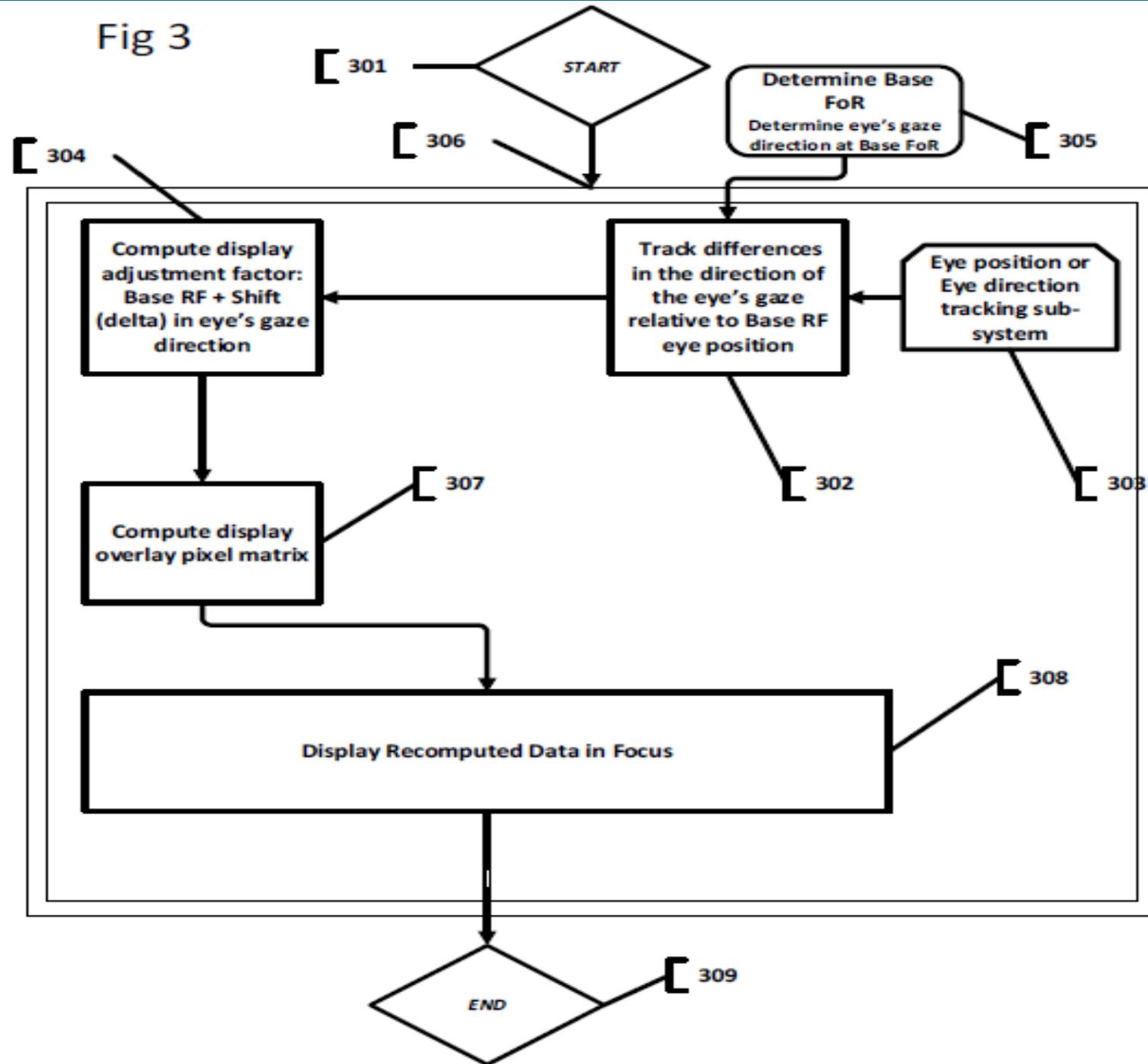
❖ Tracking: Focus change and gaze direction.

Fig 8



- SCL needs to be able to**
 - a) Determine and track focus of the eye**
 - b) Determine and track eye gaze orientation in 2D and 3D geometry**
 - c) Determine anchor point and switch from one Frame of Reference to another.**

Fig 3



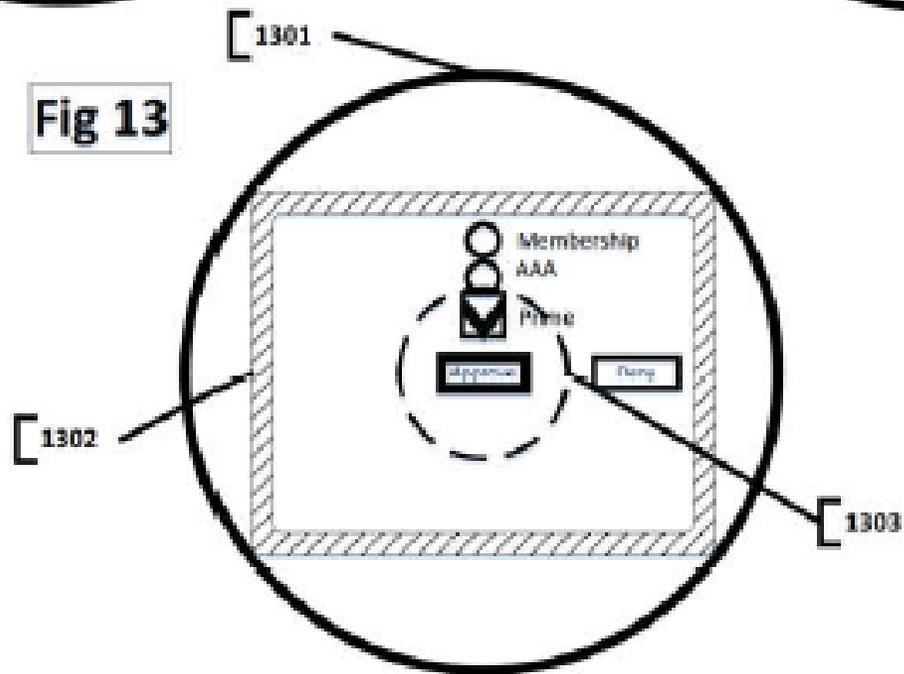
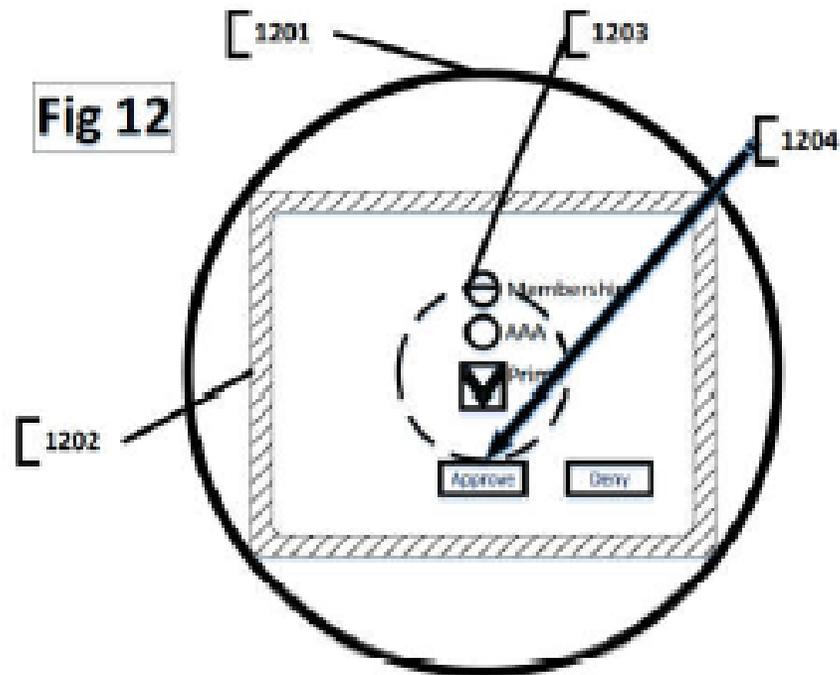
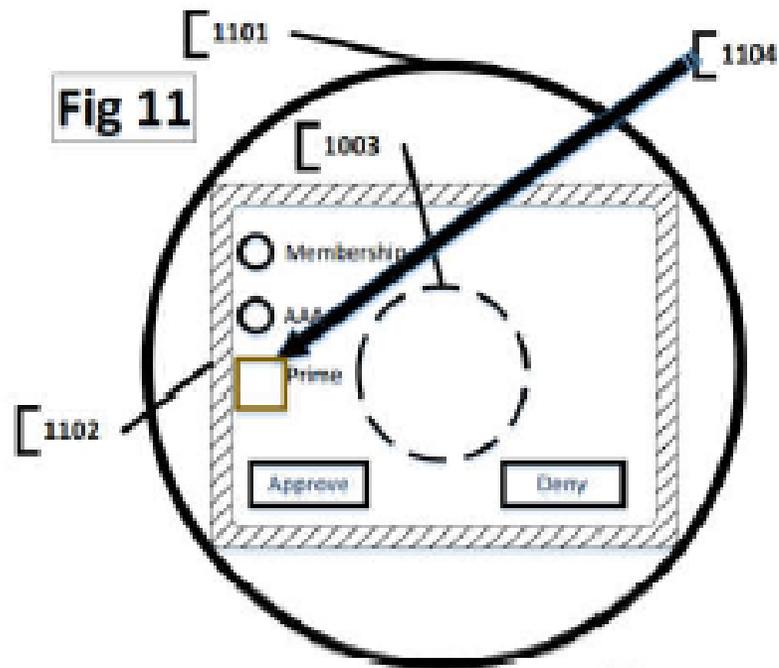
SCL SYSTEM CONTROL BASED ON EYE'S ACTIVITY.

SCL monitors eye gaze and focus and correlates gaze orientation and focus changes with the UI Components that are superimposed onto the semi transparent embedded display.

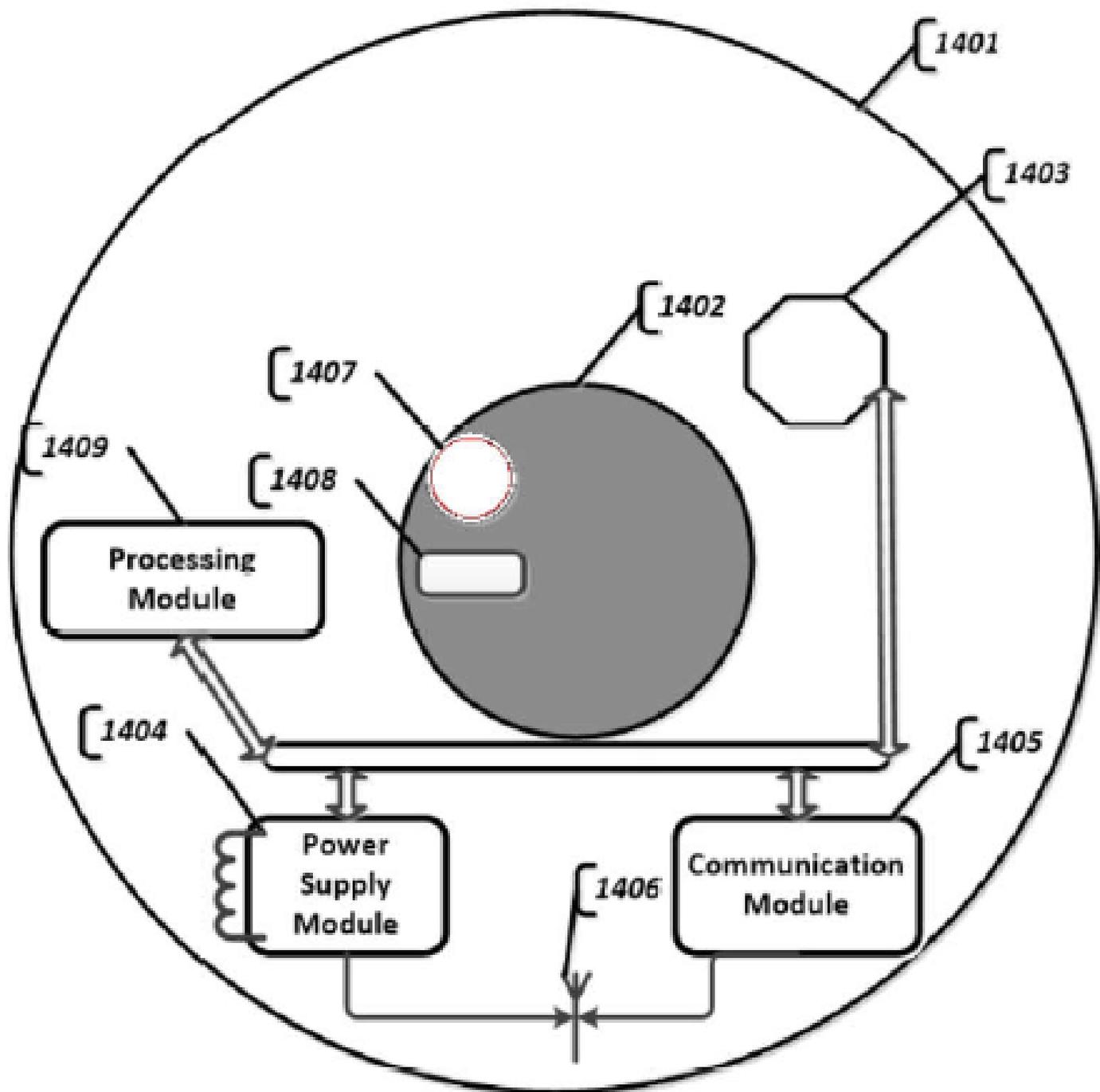
The smart contact lens system allows the user to control the system with the eye only or optionally, with an additional external triggering actions. Some UI Components carry selectable semantics. Some UI components carry command generating and trigger semantics.

Eyes movement is tracked and when selectable UI component or object superimposed on the embedded display is focused on, the UI component or the object is selected and optionally triggered.

This allows the user control over the entire system with eyes only or optionally, eye blinks, hand gestures, voice commands as other helper triggering mechanism.



For example: user utilizes eyes to focus/look at and keep focus on the red button (connoting "start of recording") for longer than certain timeframe threshold to start video recording using an embedded outward facing image capture device. Thus, control over the system is rendered with eyes only - an unprecedented capability.



Psychometrics

Psychometrics is a branch of psychology concerned with measuring variety of psychological parameters: cognitive and emotional.

**TERP – TASK EVOKED PUPILARY RESPONSE –
Pupil dilation or constriction due to mental
task engagement**

Categories of Indications of TERP

Research shows that pupil dilation may be prompted by a variety of cognitive tasks, such as attentional allocation, stimulus identification, response organization, working memory maintenance, semantic elaboration, motor output or by a variety of emotional processing, such as interpretation of affective valence.

**Great German psychiatrist and neurologist Oswald
Bumke in 1911 said:**

**“Every active intellectual process, every psychical effort,
every exertion of attention, every active mental image,
regardless of content, particularly every affect just as truly
produces pupil enlargement as does every sensory
stimulus”.**

Potential Examples of Uses of TERP Information:

Determine level of attentional effort

Determine level of difficulty for the user of arithmetic problems of different levels of complexity

Determine difficulty of language processing tasks such as reading text forwards and backwards

Determine level of complexity of mental tasks and familiarity of the user with the task.

Determine level of fatigue and alertness

Determine memory load and track difficulty of memorization

Determine subjective level of sexual attractiveness or likeness of any given person to the user

PRIMARY FACTORS EFFECTING PUPIL DIAMETER CHANGE:

1) Pupillary Light Reflex (PLR) is an unconditioned reflex, where the human ocular system strives to control pupil diameter, in response to changes in the intensity of light, which enters the eye and hits photosensitive ganglion cells on the retina of the eye. The reflex causes a change in the diameter of the pupil either a dilation/mydriasis (increase in diameter) or a constriction/miosis (a decrease in diameter); this leads to having an appropriate amount of light entering the eye for adequate visual perception to occur.

PRIMARY FACTORS EFFECTING PUPIL DIAMETER CHANGE:

2) Accommodation reflex is an unconditioned reflex of the eye, caused by the need to refocus on a near or distant object. The human ocular system achieves refocus with a triad of changes: a) a change of shape of the crystalline lens, b) a corresponding proportional change in pupil diameter, and c) a vergence, which is a simultaneous movement of both eyes in opposite directions to obtain single binocular vision. When the Subject focuses on a distant object, it also results in the flattening of the crystalline lens and an increased pupil size; whereas when focusing on a nearby object, the crystalline lens becomes more spherical and is accompanied by a decreased pupil size. The change of lens shape is required to change the refractive power of the lens.

**The basic formula is:
Total pupil dilation=PLR +
Accommodation Reflex + Pupil
Dilation due to mental state
changes (TERP)**

**Pupil Dilation due to mental
state changes (TERP)=Total pupil
dilation - (PLR +
Accommodation Reflex)**

Fig 1

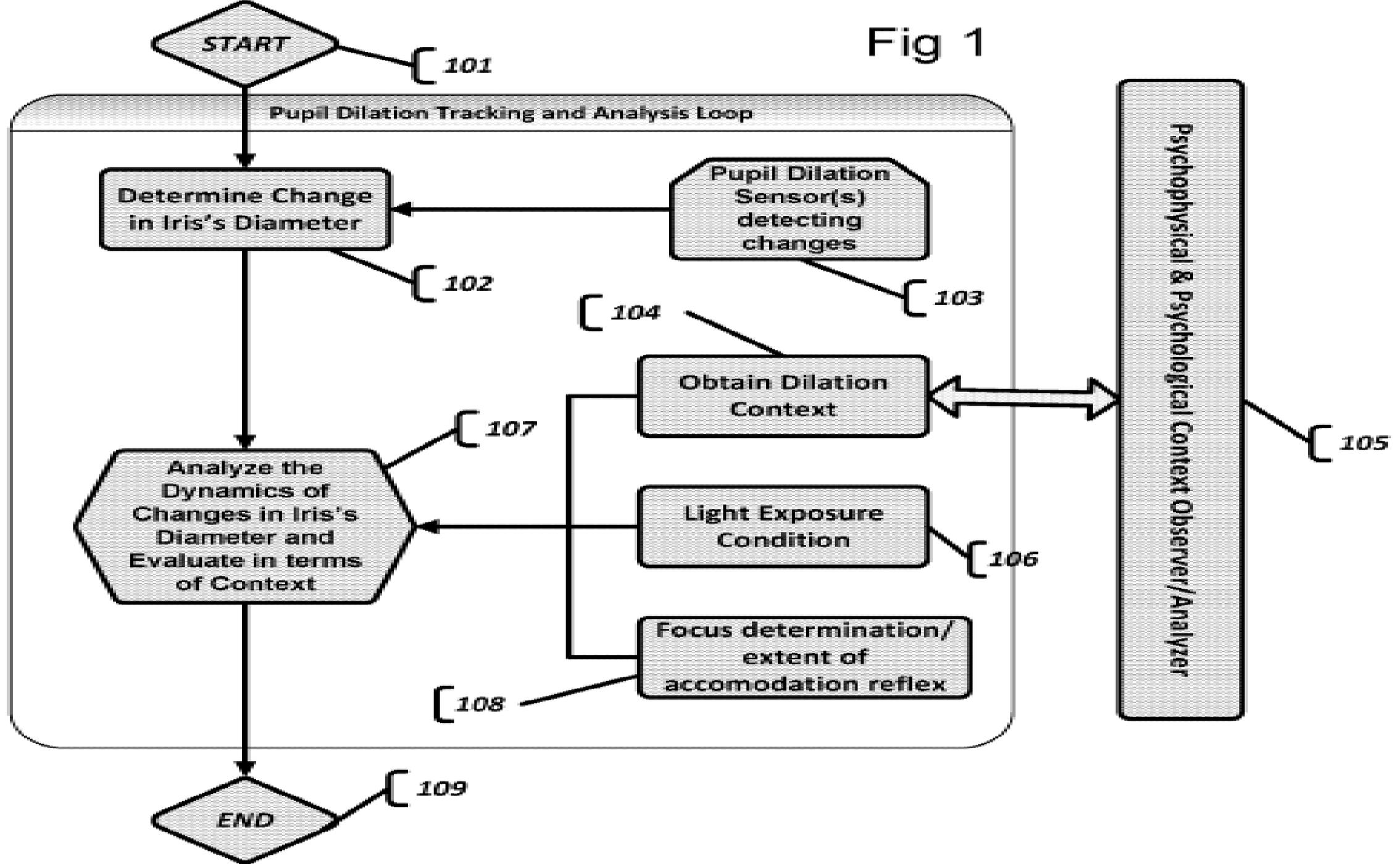


Fig 2

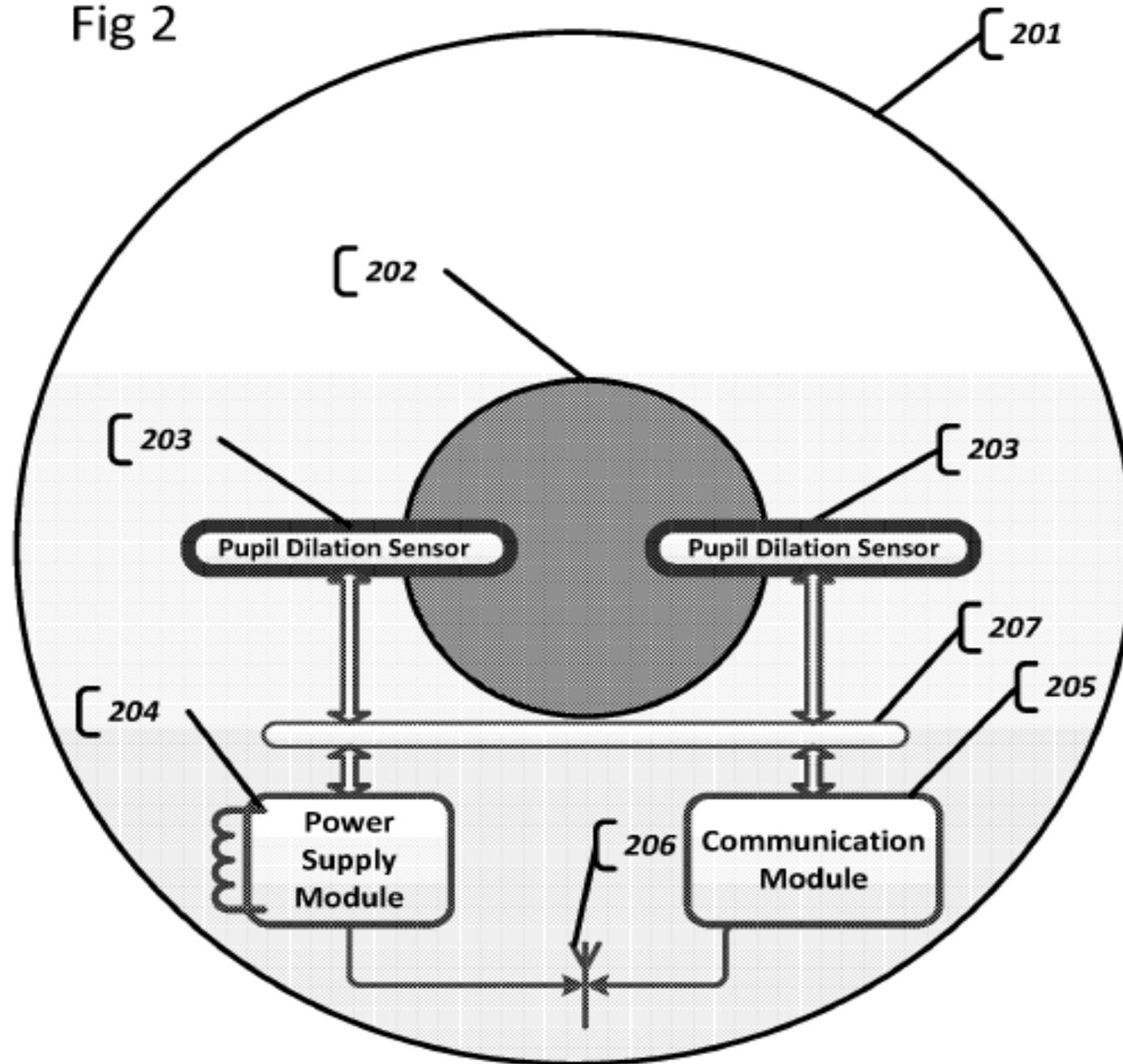
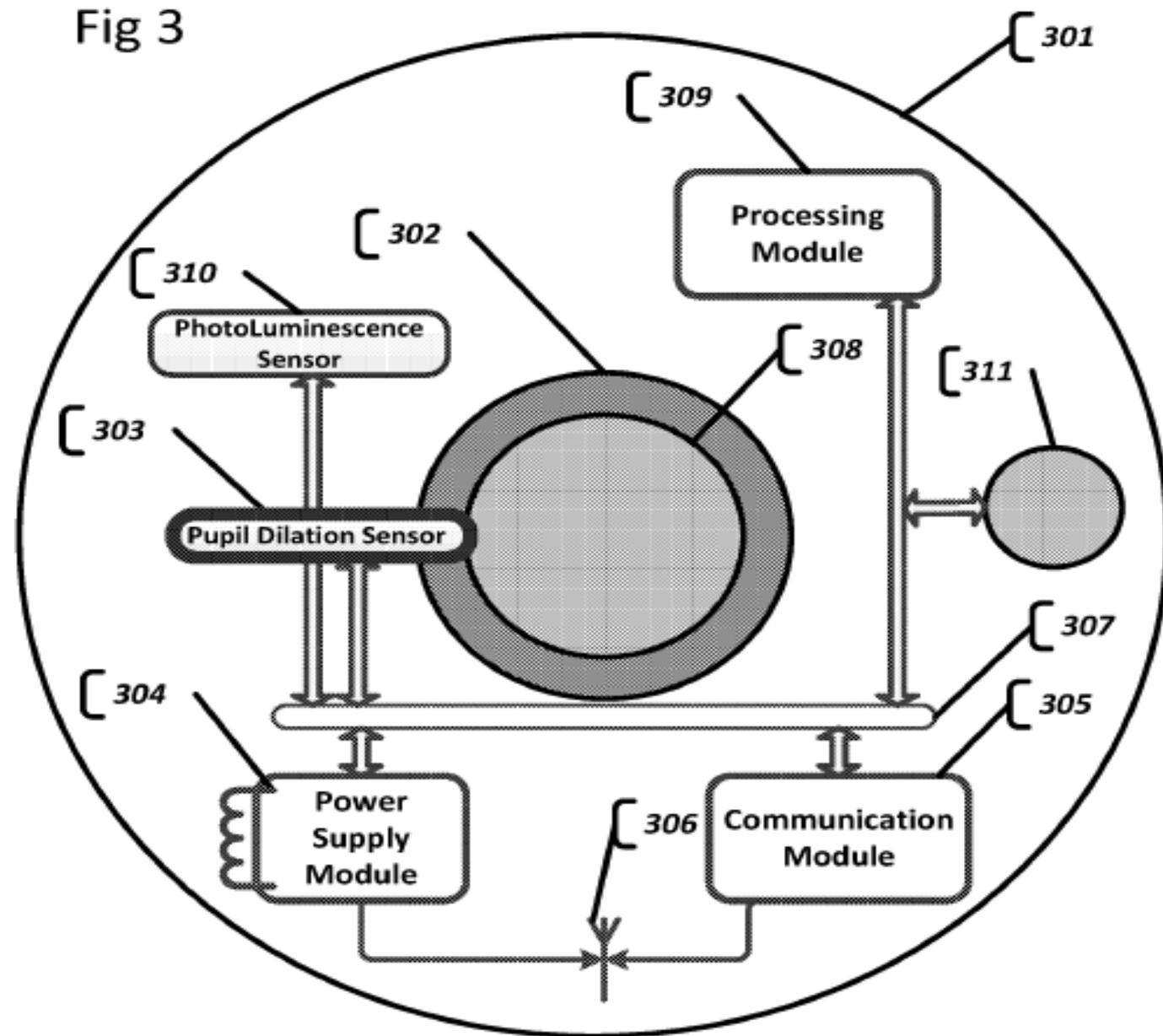


Fig 3



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