**Computer Vision Based Systems for Human Pupillary Behaviour Evaluation: A systematic review of the literature**

* Analyzing pupillary behavior is crucial for assessing neurological activity.
* Examining pupil behavior is a simple, low-cost method that can be used as a complementary diagnosis. This approach is made be recording the pupillary behavior against light stimuli and measuring the pupil diameter through the video.
* Pupil diameter based on the intensity of illumination in the eye.
* Pupillometry has a dependency on devices with ifrarred cameras. Such devices, combined with computer vision software are responsible for the image acquisition, processing and feature extraction, essential steps for pupillary behavior evaluation.
* Pupillometry systems can provide an efficient solution by extracting reliable data for medical evaluations.
* Q01. What are the specifications of devices used for image acquisition? And what are the types of environment where images are taken?
* Q02. What are the methods applied for pupil segmentation?
* Q03. What are the procedures used to induce pupillary behavior?
* Q04. What are the methods used to interpolate the blinking gaps?
* Q05. What are the features extracted for pupillary behavior evaluation?
* Q06. What are the levels of accuracy from the proposed systems?

**Eye Safety for Proximity Sensing using Infrared Light-emitting Diodes**

* All consumer products that emit light radiation – whether visible, ultraviolet, or infrared - must adhere to international standards that specify exposure limits for human eye safety.
* This Application Note serves as a guide for the product designer to Human Eye Safety when using Infrared light-emitting diodes in consumer products.
* Photobiological effects of exposure to near-infrared radiation are reviewed first, followed by brief explanations of the relevant sections of the IEC-62471 Standard document. Next, the Intersil Eye Safety Calculator is described.
* Infrared, visible or ultraviolet electromagnetic radiation, in sufficient concentrations, can cause damage to the human eye.
* With increases in LED efficiency and power, especially with application for Proximity sensing, which provides more chance for direct contact with the eye, it is critical to understand the effects of this type of exposure.
* The human eye can withstand only a finite amount of optical radiation, beyond which it can be irreversibly damaged.
* While human eye damage is much more acute from Ultraviolet (UV) and short-wavelength Blue-light exposure, excessive exposure to Near-Infrared (NIR, ~700nm to 1400nm wavelength) can cause damage to the cornea and the retina. Most Near-IR LEDs used in consumer products produce very low levels of NIR radiation and pose no threat to the human eye. However, under specific conditions and operational modes these components may produce sufficient NIR radiation to exceed IEC exposure limits.
* The most common Bioeffects caused by excessive NIR exposure are Infrared Cataract (also known as "industrial heat cataract," "furnaceman's cataract," or "glassblower's cataract") and Retinal Thermal Injury.
* The values should not be regarded as precisely defined lines between safe and unsafe levels.
* Since there is very low photoresponse to near-infrared (IR-A) radiation, worst-case pupil diameter (7mm) must be used for all retinal hazard calculations.
* The exposure limit (EL)

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* Fill in the IR-LED data from the OSRAM SFH4650 datasheet: Nominal (Center) Wavelength is 850nm; Emission Half-Angle is 15°; Maximum Radiant Intensity (for the -T version) is 50mW/sr at 100mA drive current in 20ms pulses; Rated
* Maximum Forward Current is 100mA; LED Type is Parabolic Reflector with 1.0mm diameter. The resultant Active Area of the source, then, is 0.785mm2, as shown in Figure 6.
* The Proximity Sleep Time is chosen as 100ms (a typical value that reduces sensitivity to interior lamp flicker) and the IRDR current is chosen as 110mA. The resultant Effective Average Emitted Power is 0.055mW, as shown in Figure 7.
* The LED-to-eye distance of 200mm is entered to adhere to the IEC-62471 Standard. The resultant Angular Subtense, , is 5 milli-radians, as shown in Figure 8. The Burn Hazard Weighting Function, **R**(), is 0.50, also shown in Figure 8. Lastly, the
* Exposure Time of 5s is entered in the Corneal Exposure Hazard section, as shown in Figure 9. Figure 9 shows that, for this case, the Corneal Hazard is well within the Limit. The Safety Factor is 4 x 106 - i.e., the Corneal irradiance is one-four-millionth of the Corneal Hazard Limit according to the IEC Standard. Figure 9 further shows that since the entered Exposure Time is less than 10s, the Weak Visual Stimulus Retinal Thermal Hazard does not apply and that the Retinal Thermal Hazard is 2 x 105 below the IEC Standard Limit. Now, consider the following case: The IRDR current for the ISL29028A is increased to 220mA; the LED-to-eye distance is reduced to a mere 1.0mm; and the Exposure Time is increased to 1000s (>16 minutes). The Angular Subtense of the source has increased to 1 radian due to the closeness to the Eye.
* Most infrared LEDs (and lasers) used in consumer products fall well within the Exempt Group, or Risk Group 1 (low-risk), as specified in IEC-62471.
* However, as shown in the previous example, with certain settings the SFH4560 IR-LED and the ISL29028A ALS/Proximity Sensor, can exceed eye safety limits if held 1mm from the eye continuously for nearly 17 minutes.