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Measuring Critical Flicker Fusion Frequency in Human Eye by Utilizing Sound Card of the Computer as DAC

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Abstract: Critical flicker fusion frequency is the transition point for an intermittent light of increasing temporal frequency, where the flickering ceases and the light is perceived as continuous. If the light's modulation depth is high, the CFF is the temporal equivalent of a visual acuity measurement. Different points in the visual system have very different critical flicker fusion rate (CFF) sensitivities. Each cell type integrates signals differently. For example, photoreceptors are very sluggish, whereas some retinal ganglion cells can maintain firing of rates up to 250 Hz. The flicker fusion threshold is proportional to the amount of modulation, if brightness is constant, a brief flicker will manifest a much lower threshold frequency than a long flicker. The threshold also varies with brightness (it is higher for a brighter light source) and with location on the retina where the perceived image falls: the rod cells of the human eye have a faster response time than the cone cells, so flicker can be sensed in peripheral vision at higher frequencies than in foveal vision, where it may take some increase in brightness, by powers often, to require as many as 60 flashes to achieve fusion, while for rods, it may take as little as four flashes, since in the former case each flash is easily cut off, and in the latter it lasts long enough, even after 1/4 second, to merely prolong it and not intensify it.

I. INTRODUCTION

Many electronic equipment people used now a day are actually flickering, such as lamp, TV, CRT, video, film etc. Human can detect flickering light for certain frequency, as the frequency get higher reach the threshold, human cannot see the light is flickering for longer duration of time, and then light seem as continues. This process of detection is known flicker fusion. Identifying human capability in detection of the threshold where human cannot differentiate flicker and fusion is important, particularly in designing electronic devices where light is used. Normal adult Critical flicker frequency reportedly is around 36 to 39Hertz, and it reduces as people have retinal/neural disease. CFF threshold is affected by several factors including target luminance, target color, and target size. Health impacts caused by noise can range from permanent hearing loss, cardiac and cardiovascular changes, stress, fatigue, lack of concentration, deterioration in motor and psychomotor functions and disturbance of sleep.

II. BACKGROUND

The CFF test as a reference to posturography because it allows easy realization, testing, and analysis. Cataract surgery has been established as a relatively safe and effective procedure More than 95% who undergo the cataract surgery achieve a visual acuity of 20 for 40(20/40) better if there are no associated diseases like Diabetic retinopathy, retinal disorder. However, in patients with associated disease, particularly Age-Related Macular Degeneration (ARMD), cataract surgery may result in poor visual outcomes and subsequent patient disappointment. Indeed, the benefits of cataract surgery to patients with ARMD are open to debate. Whether to recommend surgery in these patients can pose an important clinical dilemma as it is difficult to determine the relative contribution of each pathological process to the patient's existing visual disability Potential vision tests can be a valuable aid in this decision-making process if they can accurately predict visual function behind cataract and other media opacity. The usefulness of existing potential vision tests in predicting visual acuity when preoperative acuity is 20/200 or worse has been discredited in a major review by the Agency for Health Care Policy and Research. Therefore, there is a need to develop a test device of potential vision that can predict visual outcomes in eyes with very dense cataract or other media opacity where the extent of the media opacity interferes with the clinician's ability to gauge the benefit of cataract surgery in improving the patient's postoperative visual outcomes. It has been known for more than 100 years that posterior segment eye disease can impair Critical Flicker Fusion (CFF) frequency.

Recently, the CFF phenomenon has been suggested as a test of potential vision able to penetrate dense cataracts. This is because CFF has been shown to be unaffected by the presence of cataract and other media opacities, as long as a bright stimulus is used; yet, it is sensitive to retinal and optic nerve disease. Moreover, as CFF reduction from retinal/neural disease correlates

reasonably with visual acuity, it can be used to predict postoperative visual acuity. Critical flicker fusion is known to be affected by several factors including target luminance, target color, and target Size. We incorporated these factors into the design of a testing device. Working on the hypothesis that an even brighter stimulus may better penetrate dense cataract, we incorporated a brighter light-emitting diode (LED) that recently became available to double the stimulus luminance.

III. DESIGN

Software will be developed using Mat lab for generating Square wave between the range of 10-50 Hz with 50% duty cycle. So that the on period and the off period of the LED is equal. The square wave digital output is linked with the sound card of a regular computer and then the analog output is taken as a controlling signal for the LED Driver. Finally when the user sets the required frequency (10-50 Hz in steps of 1 Hz) of operation of the LED he has to set it on the screen and start the program. The output frequency can be continuously varied when the test is going on. The software will have a start and stop control.

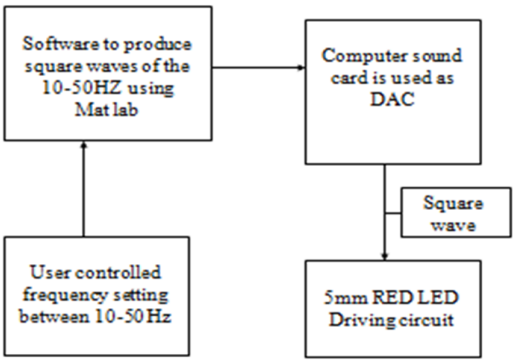

FIG 1 BLOCKS DIAGRAM

IV. APPLICATIONS

A. The relationship between the cardiovascular and visual systems was examined via critical flicker fusion frequency (CFF) and blood pressure (BP) . Outcome of the study shows BP and CFF are inversely proportional to one another.
B. Intra-occular pressure (IOP) and CFF are inversely proportional to one another.
C. CFF scores accurately predict the postoperative visual acuity in the pre-and post-cataract surgery studies.
D. Critical flicker fusion frequency (CFFF) is often used for research purpose and also for diagnostic purpose in clinical practice. For example to assess cognitive function, central nervous system arousal in neurology and Pharmacology.
E. Systemic hypertension, the most prominent risk factor for cardiovascular disease is the condition most commonly associated with visual diseases such as branch retinal vein occlusion and macular degeneration.

V. CONCLUSION

The CFF phenomenon effectively discriminated between subjects with and without retinal/neural disease and accurately predicted visual outcome after cataract surgery the use of a brighter stimulus enhanced performance in cases of dense media opacity.

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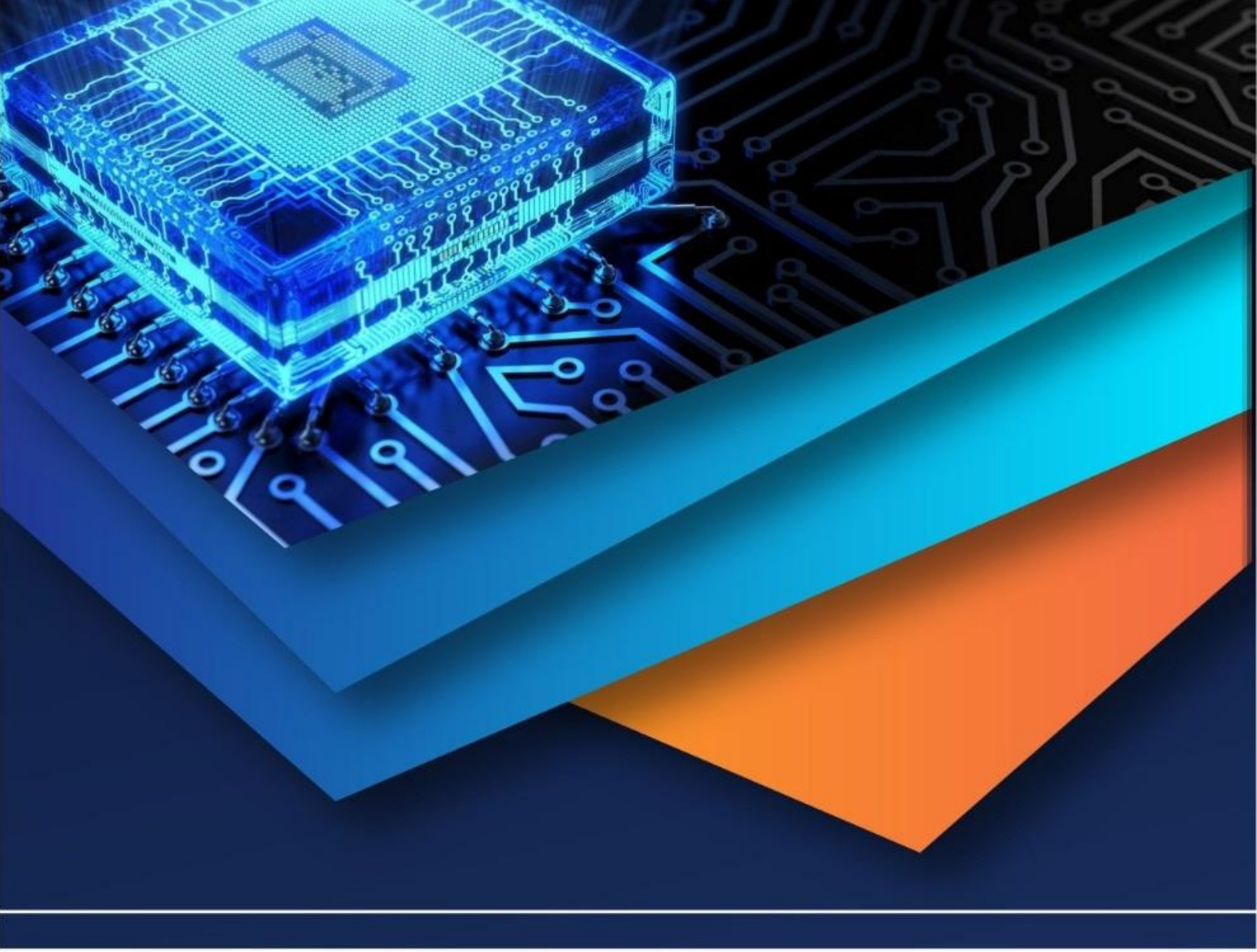

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