JuneBrain

White Paper

Revolutionizing Retinal Imaging: The Wearable Solution for Transforming Health Care Delivery

Improving accessibility to eye care, our wearable retinal imaging device delivers flexible and far-reaching solutions to underserved communities.

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Executive Summary

Neurological diseases such as multiple sclerosis (MS), Alzheimer's disease (AD), and Parkinson's disease (PD) are debilitating conditions that affect an individual's overall quality of life. Being that the retina is an extension of the central nervous system (CNS), retinal imaging offers a non-invasive approach to understanding brain health. The timely detection of these conditions is of utmost importance as it can facilitate effective intervention, and subsequently improve disease outcomes.

However, commercially available retinal imaging devices are often bulky, costly, require skilled technicians to operate them, demand patients to actively cooperate, occupy huge real estate, and are usually seen only in eye care clinical settings. These limiting factors thereby lead to inaccessibility within the healthcare system. To solve these issues, we introduce a novel wearable retinal imaging device specifically designed with accessibility and comfortability in mind.

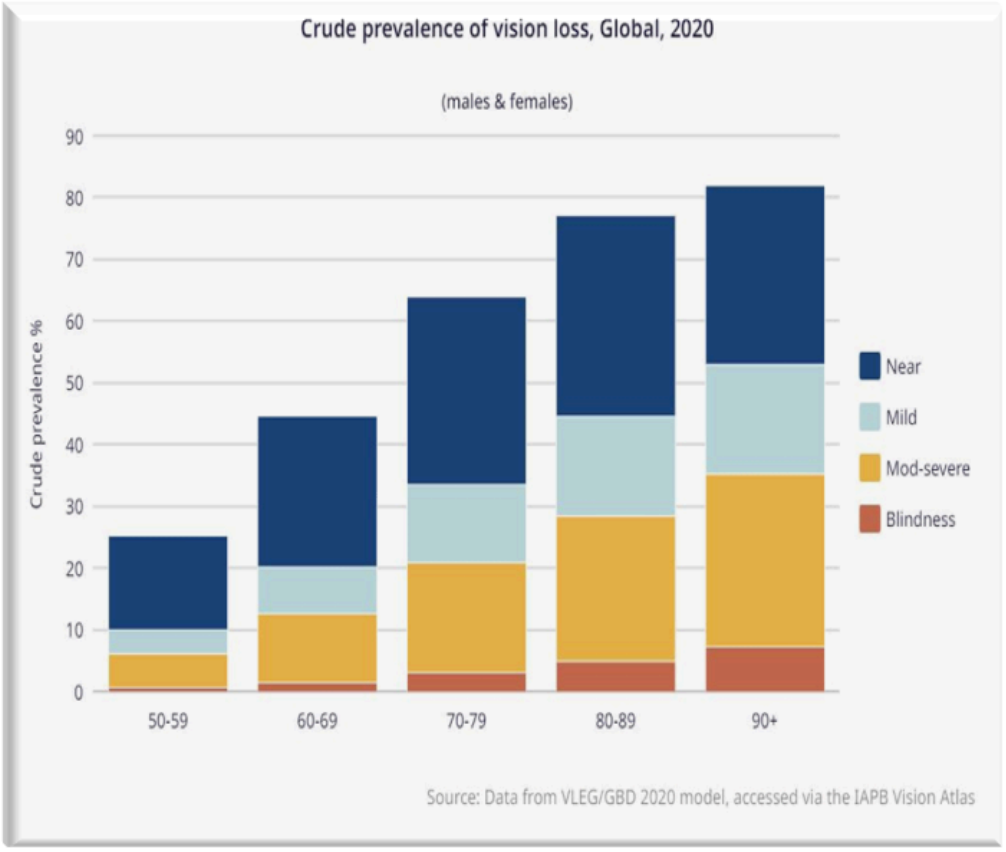
JuneBrain Inc. offers a portable, non-invasive, cost-effective, user-friendly retinal imaging solution for improving early detection and monitoring of neurodegenerative changes. This innovation can be used in non-traditional clinical settings, thereby enhancing accessibility to retinal imaging technology, especially in underserved communities.

This white paper highlights our revolutionary approach to retinal imaging in the diagnosis and management of neurodegenerative conditions which may eventually improve an individual's overall outcome.

Introduction

Globally, visual impairment affects two hundred and eighty-five million people. Of this number, thirty-nine million people are blind and the remaining two hundred and forty-six million have impaired vision. [1] Systemic and neurodegenerative disorders such as age-related macular degeneration (AMD), diabetic retinopathy, multiple sclerosis (MS), Alzheimer's disease (AD), and Parkinson's disease (PD) have been attributed to visual impairment [2] which consequently impacts an individual's health-related quality of life. [3]

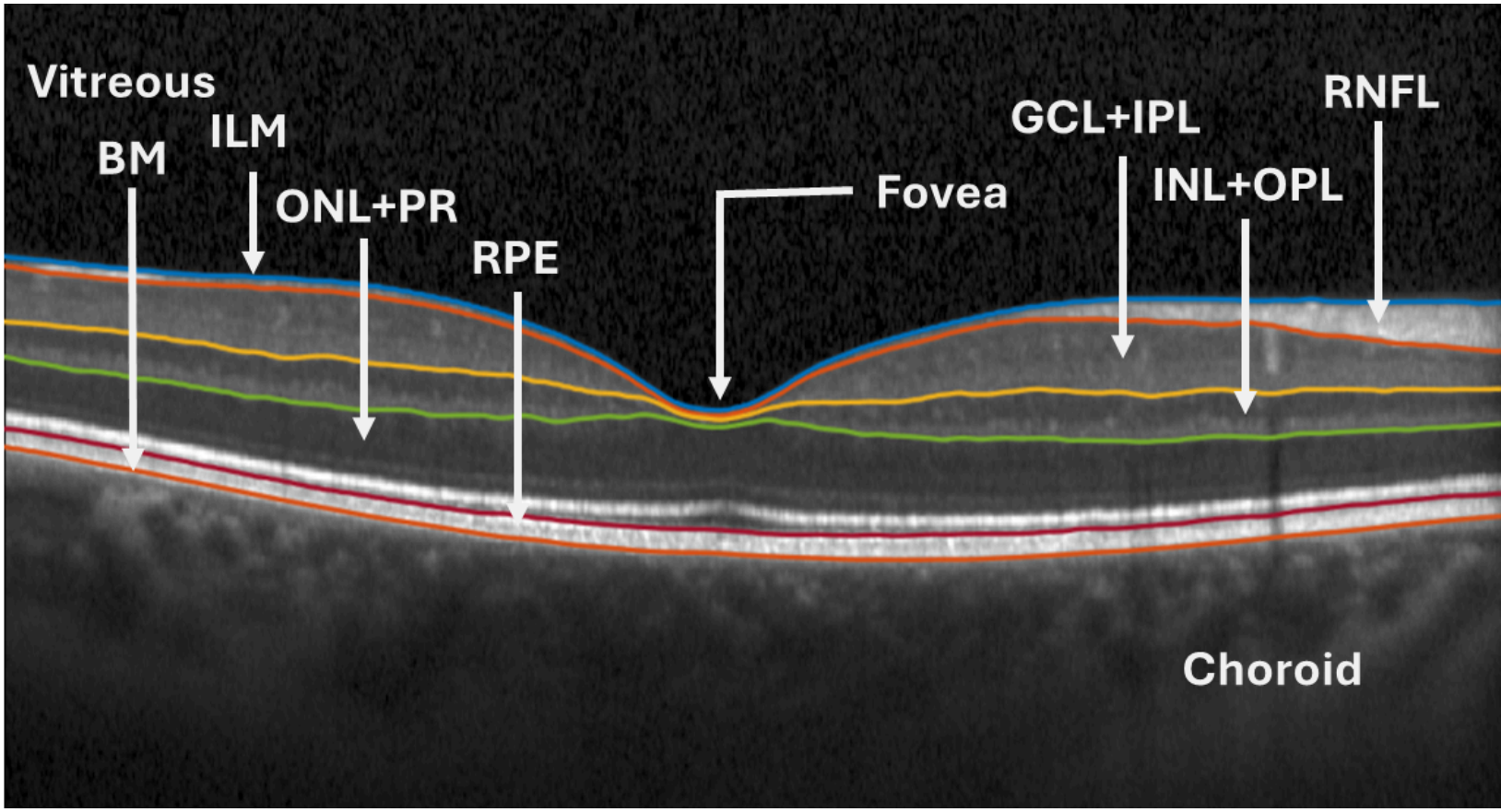
Early intervention is crucial in the management of these conditions as it can improve symptoms and slow progression. However, many individuals lack access to screening tools that can identify neurodegenerative-related changes in preclinical or early symptomatic stages. In neurological clinics, the current diagnostic process relies on clinical assessment, cognitive testing, magnetic resonance imaging (MRI), positron emission tomography (PET), and cerebrospinal fluid analysis.



However, these methods have limited accessibility due to high costs, infrastructure requirements, and the need for specialized personnel. [4] Hence, there is an immediate requirement for readily accessible and non-invasive screening techniques that facilitate the early detection of neurodegeneration before the onset of debilitating clinical symptoms.

The retina, as an extension of the CNS, shares anatomical and functional similarities with the brain and spinal cord, as well as similarities in response to injury and immunological characteristics. The manifestations of several major neurodegenerative disorders in the retina suggest that the eye can serve as a mirror of the brain. Due to the structural and accessible characteristics of the retina, it is a convenient tool for investigating activities in the CNS. Advancements in retinal imaging techniques further support the potential of these methods as effective tools for the noninvasive diagnosis of neurological disorders. [5]

In eye care, Optical Coherence Tomography (OCT) technology is the gold standard imaging modality for retinal imaging. OCT is a non-invasive, rapid, high-resolution imaging technique that allows microstructural analysis of the eye, including retinal layer thicknesses and microvascular networks. OCT technology is especially useful in detecting retinal changes that precede neurological symptoms or signify neurodegenerative progression in the brain. For example, people with neurodegenerative diseases such as MS and AD have shown significantly thinner retinal nerve fiber layers (RNFL) and ganglion cell inner-plexiform layers (GCIPL) compared to healthy controls. [6][7]



Advantages and Challenges of Current Retinal Imaging Techniques

In contrast to conventional diagnostic methods such as cognitive testing, MRI, PET, and cerebrospinal fluid analysis, retinal imaging provides a non-invasive, cost-effective, and more readily accessible means of assessing various neurological disorders. This approach facilitates early detection and longitudinal monitoring of neurodegenerative disease progression, offering valuable data for improving neurological diagnosis and providing essential metrics for therapeutic trials. [8].

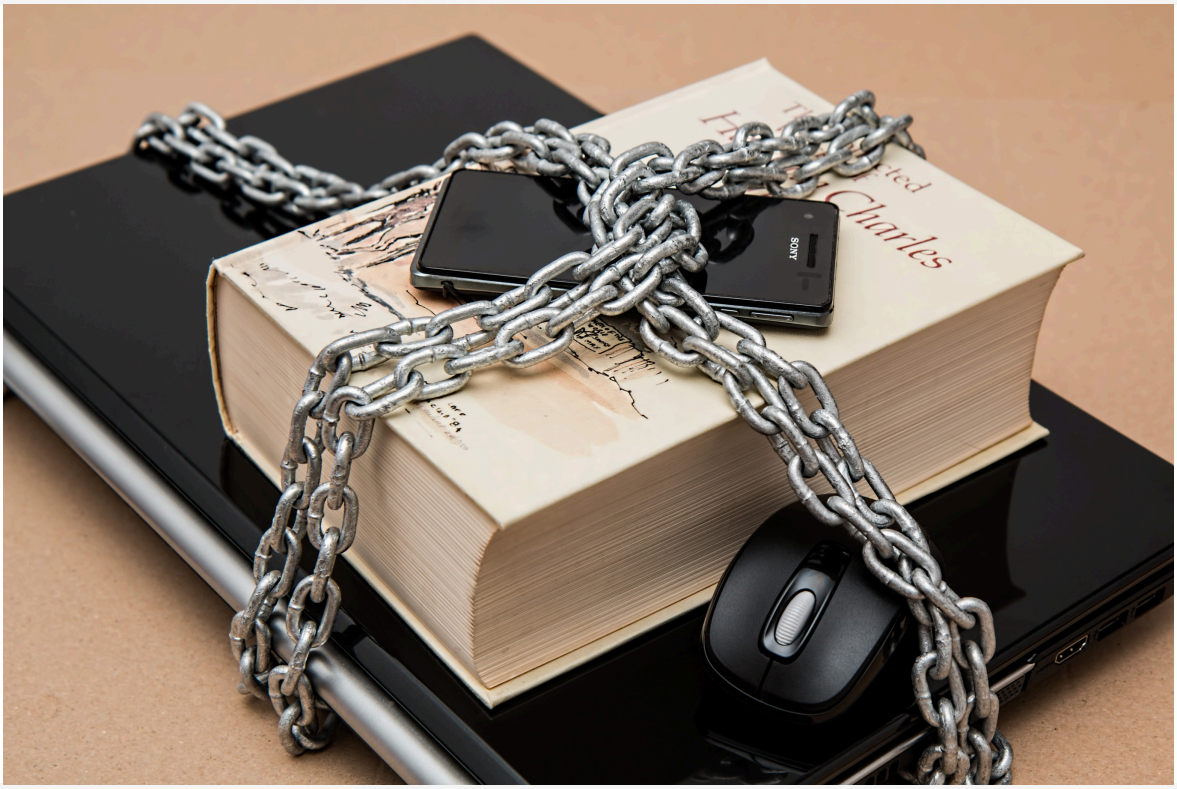
Current OCT retinal imaging devices offer significant advantages, yet they are impeded by several limitations, particularly for individuals with mobility challenges. These limitations include bulkiness, high cost, and the requirement for a considerable amount of space in traditional clinical settings, thus constraining the widespread application of this invaluable technology.

BULKINESS

Most commercially available OCT machines are large and immobile, requiring a considerable amount of space. This lack of portability restricts the use of OCT technology to clinical settings and limits its potential applications in non-clinical environments.

HIGH COST

A major impediment to the widespread adoption of current OCT machines is their high cost, particularly in underserved regions. The expensive nature of these devices makes them less accessible to healthcare facilities and patients in regions with limited resources.



LIMITED ACCESSIBILITY

Individuals with mobility limitations, such as those with chronic neurodegenerative diseases, might encounter difficulties in using existing OCT devices. The configuration and arrangement of these machines may not be suitable for accommodating individuals with mobility impairments, thus restricting their ability to utilize this crucial diagnostic technology.

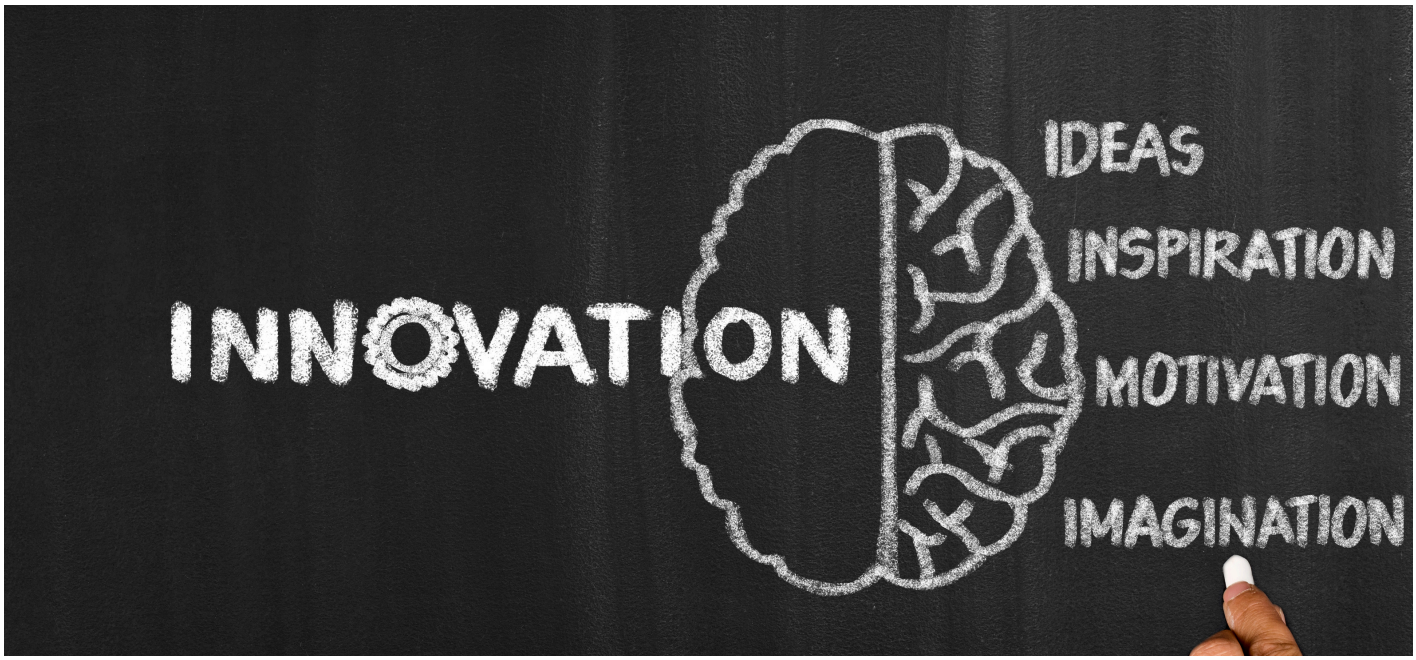
Furthermore, the complexity of current OCT machines demands the expertise of highly skilled operators, rendering them impractical for use in non-traditional clinical settings. Other constraints include portability, user-friendliness, challenges with frequent clinic visits, long-term continuity of care, and the communication of OCT retinal data. Among these constraints, bulkiness and high costs significantly contribute to the inaccessibility of OCT technology in underserved populations. [9]

The Wearable Solution

To address these limitations, we introduce an innovative wearable retinal imaging device that offers the potential to enhance the accessibility of retinal imaging for early detection and monitoring of clinical parameters in diverse patient populations, within a variety of point-of-care and clinical settings.

JuneBrain has developed the Neuro-i swept-source OCT (SS-OCT) system, a wearable, user-friendly, AI-powered retinal imaging device designed to noninvasively detect retinal changes associated with neurodegenerative diseases.

Unlike commercial OCT machines, the Neuro-i SS-OCT device is cost-effective, portable, and operates with an automated deep learning algorithm for image segmentation. [10] This feature allows the device to generate summary reports to aid healthcare providers in evaluating disease progression and treatment effectiveness, in clinical and non-clinical environments.



Early Detection and Monitoring of Disease Progression

The ability to acquire retinal scans in non-traditional clinical environments, such as nursing homes and assisted living facilities, has the potential to enhance the accessibility of OCT technology in a timely manner. For instance, preliminary studies have shown that this portable OCT device could capture retina images of people with MS (PwMS) who have chronic neurological disabilities or are bedridden. This potentially allows for rapid and more frequent monitoring of disease progression in PwMS, reducing the necessity for transferring patients to specialized clinical facilities.

Telemedicine and Monitoring

The Neuro-i SS-OCT device has the potential to be easily integrated into telemedicine platforms, which could enable the remote monitoring of subtle retinal changes associated with neurological disease progression.

Improved Patient Outcomes

Enhanced access to healthcare has a direct impact on the early detection and management of neurodegenerative disease activity, thereby leading to improved patient outcomes and a higher quality of life.

In terms of performance, studies have shown that the device matches traditional clinic-based OCT machines and surpasses them with its deep learning algorithm, which automatically assesses retinal layer thickness, including the RNFL and GCIPL. The Neuro-i device presents an unprecedented opportunity to revolutionize the screening of neurodegenerative diseases by enabling the early detection of retinal biomarkers.

In pilot studies, the Neuro-i SS-OCT device has shown effectiveness in capturing images while individuals are in a supine position. This capability is particularly advantageous for individuals experiencing limited mobility due to neurodegenerative conditions, as it addresses the challenges of accessing conventional bulky and immobile OCT devices.

The design of JuneBrain's products is informed by direct feedback from hundreds of patients, neurologists, eye care specialists, health plans, laboratories, and retail stores. They are dedicated to seeking advancements and transformative innovations in this field to consistently deliver high-quality OCT retinal imaging.

Conclusion

Through the utilization of advanced retinal imaging technology, which incorporates deep learning algorithms to enhance the precision and accuracy of disease detection, significant strides have been made. Additionally, the ongoing evolution of wearable and portable devices is poised to extend the availability of retinal imaging, ultimately contributing to improved outcomes and an enhanced quality of life for those impacted by neurodegenerative diseases.

In summary, the retina serves as a valuable biomarker in identifying early indications of neurodegenerative activities. JuneBrain's innovative wearable SS-OCT solution represents a noteworthy advancement in bridging this gap and realizing its potential. By harnessing this cutting-edge technology, we can empower healthcare providers and individuals with neurological conditions to adopt a more proactive approach to managing neurodegenerative activities.

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