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Research Article

AI-Enabled Bionic Eye and Artificial Vision System “AI – Enabled Mobile Bio-Eye-Tronic System” Based on the Scientific Framework of "Elmas’s Theory of Thermodynamics"

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Abstract: In this article, I have attempted to explain how the bionic eye artificial vision system, which I have tried to develop in my previous studies and which I call the "Mobile Bio-Eye Tronic" system, can find an application area with the support of artificial intelligence.

In this designed system, first, image data detected by the camera in the existing "Mobile Bio-Eye Tronic" system will be converted into another digitally processed image using artificial intelligence. Then, a digital-to-analog signal conversion will be performed, and the analog signal will be transmitted to the neurons, and the surrounding image will be brought to life in the person's brain by artificial intelligence. The patient will perceive their surroundings as if they were watching a film that closely resembles what they see with their own eyes. In other words, for a visually impaired patient, a realistic virtual image will be created using the surrounding images, allowing the person to see in a way similar to watching a film. Image processing techniques will also be used for these processes.

This article aims to address the needs of hundreds of thousands of individuals, striving to assist them in fulfilling their daily activities, even partially, while enhancing the quality of life for visually impaired people and supporting their health improvement. Furthermore, the scientific and technical research conducted in this field is expected to contribute to the existing body of knowledge and foster progress in science and technology. Current studies on bionic eyes reveal no other system that achieves results by integrating a mobile phone camera and software, making the bionic eye proposed in this article a ground breaking innovation. Yet, the global cost of using bionic eyes and artificial vision systems for individual patients remains remarkably high. When imported into certain countries, these costs often escalate further. Additionally, variations in visual performance and quality among different bionic eye systems can complicate accessibility. Leveraging the infrastructure of mobile phones presents a highly cost-effective and practical solution for patients seeking access to bionic eye technology. This approach, which uses mobile phones as a foundation, not only reduces the overall cost of the system compared to existing solutions but also makes these devices more accessible. As a result, patients can afford this novel technology more easily, leading to a notable improvement in their quality of life.

This article introduces the Mobile Bio-Eye-Tronic System, an innovative artificial vision system designed to assist individuals who are visually impaired, including those who are completely blind or experiencing significant vision loss. The Mobile Bio-Eye-Tronic System represents a fully original concept developed exclusively by the author, Emin Taner Elmas. The ELMAS Thermodynamic Theory (ELMAS’s Theory of Thermodynamics”: A Scientific Approach for 5th Law of Thermodynamics) [1] provides a valuable framework for understanding the medical treatment of patients through the use of various medications

or drugs. In this theory, human cells are viewed as open thermodynamic systems, meaning energy and matter can flow across cellular boundaries when a drug is administered. The therapeutic impact emerges from these thermodynamic exchanges between the drug and the cells within the system. Depending on the nature and dynamics of these interactions, treatment can lead to positive, negative, or neutral changes in energy and matter within cellular structures. According to ELMAS's Thermodynamic Theory, effective medical treatment requires precise regulation of these thermodynamic interactions, which can shift in positive, negative, or neutral directions. During these processes, energy and matter behave as dynamic parameters, comparable to "force" or "velocity," driving therapeutic bioprocesses. Throughout this systemic interaction, Total Energy and Total Mass across cellular boundaries aim to reach a state of balance. Essentially, the cumulative positive, negative, and neutral shifts in energy establish one equilibrium, while the corresponding shifts in matter form another interconnected balance within the human body's cells.

When these systems are introduced into our country, their costs tend to escalate significantly. Furthermore, the visual capabilities and overall quality of these bionic eye systems can vary widely. Utilizing the existing mobile phone infrastructure represents a highly economical and practical approach for enabling patients to access the bionic eye. Relying on mobile phone technology as a foundation not only simplifies the process but also drastically reduces the cost compared to other available methods, making the bionic eye more affordable for patients. As a result, individuals will have easier access to this technology, leading to a notable improvement in their quality of life. The Bionic Eye and Artificial Vision System under development will pioneer the use of mobile phone infrastructure, marking its first application in this field. This system aims to deliver enhanced visual performance while prioritizing cost-effectiveness in its design. Moreover, the system is part of a local and national initiative aimed at fostering technological advancement within our country, which will provide significant economic benefits. In conclusion, this project carries immense importance not only for advancing human health but also for contributing to scientific, technological, and economic progress. Additionally, this endeavour holds particular significance for our institution, Iğdır University in Turkey, as it integrates healthcare, science, and technology into a unified, ground breaking effort. [20], [40], [42]

Keywords: AI, Artificial Intelligence, AI-Enabled Mobile Bio-Eye-Tronic System, ELMAS's Theory of Thermodynamics, Bionic Eye , Artificial Vision System, Mobile Bio-Eye-Tronic System, Cataract, Sight – Loss, Vision Loss, Visual Impairment, Vision Impairment (VI or VIP), Blindness, Applied Medi-Ultrasound Eye-Tronic Method.

Introduction

This article explains the functioning and potential application of the bionic eye artificial vision system, which I refer to as the "Mobile Bio-Eye Tronic" system—a concept developed in my earlier research. The primary aim is to explore how artificial intelligence can support and enhance this innovative technology. In the proposed system, the camera integrated within the "Mobile Bio-Eye Tronic" detects image data from the surroundings, which is then digitally processed through artificial intelligence. This processed image undergoes digital-to-analog conversion, enabling the analog signal to communicate with the neurons in the brain. Through this process, the surrounding environment is brought to life in the patient's brain with the aid of AI technology. The result is akin to watching a film that closely simulates normal vision. For individuals with visual impairments, this approach generates a realistic virtual image, allowing them to perceive their surroundings in a way comparable to watching a cinematic representation. Advanced image processing techniques will be utilized to ensure the system functions effectively and achieves its intended outcomes. [20], [40], [42]

Bionic eyes, or visual prostheses, are designed to restore partial vision for individuals who have lost their sight. These cutting-edge devices function through the use of micro-electrodes surgically implanted either in or near the eye, along the optic nerve—which transmits visual signals—or directly into the brain. The electrodes stimulate working parts of the visual system with tiny electrical pulses, a process similar to how cochlear implants aid hearing. By activating surviving neurons, this stimulation enables the user to perceive small points of light known as phosphenes. Phosphenes are light sensations that occur without actual light entering the eye, resembling the visual patterns observed when closing one's eyes tightly. For individuals equipped with a bionic eye, these phosphenes are configured into patterns that form a rough visual interpretation of their surroundings. However, unlike natural sight, the artificial vision provided by bionic eyes manifests as dynamic flashes of light and shapes. With practice and training, users learn to interpret these "flashing mosaics" to better navigate their environment. At this stage, the visual clarity achieved by bionic eye technology remains limited, enabling users to perform basic tasks such as locating objects, identifying people nearby, or recognizing doorways. Efforts by researchers to enhance these devices aim to deliver higher-resolution vision, but significant technical and biological challenges persist. The functionality of a bionic eye begins with visual input captured by an external video camera. This input is converted into a high-contrast image. A specific portion of this image—typically representing the reduced field of view offered by the bionic eye—is selected for further processing. An external video processor then translates this segment into electrical stimulation parameters, which are sent to electrodes implanted inside the eye. The resulting perception for the user is a blurred image, composed of light pulses, that helps them interpret and interact with their environment. [1-52]

The way individuals perceive these signals is often influenced by their unique experiences, as noted by some users. For example, the activity generated by the electrodes may be experienced as sporadic, bright flashes rather than a steady visual sensation. These bursts of light are arranged to reflect an object’s key characteristics—its height, width, and approximate location—essentially providing a rough outline of what is captured by the camera. Some have compared this phenomenon to gazing at a starry night sky filled with countless flickering lights, which may initially appear disorganized. Recipients must interpret these irregular flashes to derive visual meaning from the input provided by the camera. That said, the observable field of vision is quite restricted, spanning only about 30 degrees, which is comparable to the width of an outstretched hand at arm’s length. This limited scope demands a strong reliance on memory to piece together a cohesive image over time. Improvements in external cameras and video processing are playing a key role in refining this experience. Advanced features like distance-sensing cameras can help pinpoint nearby obstacles, such as trash bins along a sidewalk, while thermal cameras are useful for distinguishing human forms. Ultimately, optimal results rely heavily on the recipient's willingness to engage, consistent effort, and thorough participation in rehabilitative training. [1-54]

Material, Method and Discussion

Implants placed on the optic nerve or directly within the brain offer promising possibilities for helping individuals affected by conditions such as injuries or glaucoma. Although these technologies are still in the experimental phase, their progression toward human clinical trials seem imminent. The effectiveness of vision restoration using retinal implants depends to a large extent on the patient’s remaining eye health and their capacity to interpret the phosphenes—or visual sensations—produced by the device. These implants utilize electrodes designed to emulate the function of damaged light-sensitive cells, known as photoreceptors. However, their success relies on the presence of functional and surviving neurons capable of interacting with the implanted electrodes. An additional obstacle lies in the complex diversity of neuron types within the retina. The current size of these electrodes restricts their ability to precisely target specific neurons, which is why bionic eyes cannot yet replicate colour vision. In reality, the experience of artificial sight is markedly different from natural vision and requires considerable adjustment from users. To improve image quality in artificial vision systems, researchers are exploring various strategies. One promising avenue involves increasing the number of micro-electrodes while simultaneously reducing their size. This could allow for more precise targeting of individual neurons, resulting in sharper visual "pixels" and enhanced resolution overall. Advances in nanotechnology materials may soon enable the creation of ultra-miniature electrodes capable of producing highly detailed visual outputs. Another approach focuses on refining electrical stimulation patterns to direct neural activity toward smaller, more specific clusters of neurons. Additionally, engineering "virtual electrodes" by distributing electrical currents across multiple physical electrodes could further enhance resolution artificially. With these innovations, it may even be possible to introduce basic colour perception over time. A critical long-term objective is to decode and replicate the retina's neural signalling processes, which determine how visual information is transmitted to the brain. Successfully mimicking the intricate firing patterns of photoreceptors could enable bionic systems to deliver more accurate and realistic visual data, significantly improving users’ experiences. The vision these advancements hold is transformative: enabling individuals with visual impairments to move through their environments independently, recognize familiar objects, and even perceive emotions on the faces of loved ones. While it's uncertain which approach will ultimately yield the best results, it is clear that progress in bionic eye technology continues steadily. Still, significant hurdles must be overcome. The variety of neuron types within the retina and the present limitations in electrode size make it difficult to selectively target specific neurons with precision. As a result, current bionic eyes are unable to achieve natural colour vision. Overall, artificial sight today remains far from replicating normal eyesight and entails significant adaptation from those who rely on these systems. However, with ongoing advancements, the potential for revolutionary improvements remains strong. [20], [40], [42]

The "ELMAS Thermodynamic Theory" [1] provides an insightful framework for comprehending the medical treatment of patients through the use of various medications or drugs. Human cells are viewed as open thermodynamic systems, enabling the exchange of energy and matter across cellular boundaries when a drug is introduced to the body. The therapeutic effects stem from these interactions within the open system, as the drug engages in thermodynamic exchanges with the cells. Depending on the nature of this interaction, the resulting bioprocess can lead to changes—whether positive, negative, or neutral—in the cellular matter and energy. This theory underscores that effective medical treatment relies on carefully managing these thermodynamic exchanges, which may progress in any directional pattern as positive, negative, or neutral. Energy and matter function as dynamic parameters in these processes, akin to forces or motion within a system. As the treatment unfolds, total energy and total mass within the cells naturally strive to reach a state of balance across their boundaries. This equilibrium involves a dual process: energy contributions—whether beneficial, detrimental, or neutral—combine to form one balance, while matter contributions independently establish their corresponding equilibrium, interconnected within the system. By achieving this vectorial alignment of energy and matter in every relevant cell, the medication or drug administered begins to exert its intended therapeutic impact, addressing the disease in focus. Consequently, comprehending these thermodynamic interactions between pharmaceutical agents and human cells emerges as essential for optimizing treatment effectiveness and fostering healing outcomes. [1-54]

Both energy and matter inherently hold the capacity to perform work or manifest as heat, facilitating more effective thermodynamic interactions that support the completion of medical treatment and the healing process. This idea exemplifies the practical application of the ELMAS Theory of Thermodynamics within medical interventions, positing that energy and matter can be conceptualized as vectorial parameters operating within a defined system. Additionally, this phenomenon provides empirical evidence for the ELMAS Theory of Thermodynamics, which could be considered a scientific framework in alignment with a proposed fifth law of thermodynamics. Cataractogenesis is characterized by the gradual aggregation of crystalline proteins within the eye's lens, compromising optical transparency and interfering with the seamless transmission of light to the retina. In its early stages, these protein clusters are typically small and localized, causing minor visual impairments that often evade early detection. However, as their density increases, patients frequently experience reduced visual acuity marked by a loss of sharpness and pervasive blurring. A notable aspect during this progression is the phenomenon known as a myopic shift, a temporary improvement in near vision caused by changes in the lens's refractive index. This phase ultimately leads to significant visual deterioration as light traveling through the cornea becomes obstructed by the increasingly opaque lens. The physiological process of vision relies on the lens to focus incoming light precisely onto the retina, a layer of light-sensitive neural tissue at the back of the eye. Before reaching the retina, light must pass through the vitreous humor, a transparent, gel-like substance that preserves the eye's structural stability. Once optical signals are captured by the retina, they are processed into neural impulses and transmitted via the optic nerve to the visual cortex. Pathologically, cataracts generally result in progressive, bilateral opacification of the lens, although the rate of vision loss often varies between the two eyes. As the concentration of proteins within the lens rises, noticeable visual disturbances occur, including reduced contrast sensitivity and clarity. These clinical manifestations include difficulty performing tasks in dim lighting, such as night-time driving, and diminished ability to discern fine details or recognize facial features, often accompanied by a fading perception of colours. Progressive cataract development frequently involves the accumulation of chromophores within the lens, leading to distinct yellowish or brownish discoloration that acts as a spectral filter, distorting colour perception and further reducing contrast sensitivity. While refractive errors initially caused by lens opacification may be managed temporarily with updated corrective lenses, this approach becomes inadequate as the cataract density grows. In advanced stages, profound visual impairment necessitates surgical treatment to restore functional vision essential for activities such as driving and performing routine tasks. Although cataracts are a common age-related condition, their effects go beyond mild visual blurriness. Left untreated, continued lens opacity can result in complete blindness, making cataracts one of the leading causes of reversible blindness worldwide. [1-54]

This study also establishes a connection with an innovative non-surgical approach to treating cataracts, offering an alternative to conventional cataract surgery. Named the "Medi-Ultrasound Eye-Tronic Method" or "Applied Medi-Ultrasound Eye-Tronic Method," this technique is a novel concept developed and proposed by the author, Emin Taner Elmas. Its implementation would follow a step-by-step development process. Cataract formation occurs when proteins in the eye's lens clump together, obstructing the clear passage of light. This method proposes treating cataracts by breaking down and dissolving these protein clusters within the lens. A similar principle was explored in a previous study by the author titled "Medical Treatment Method of Alzheimer's Disease & Parkinson’s Disease by the Help of the Natural Musical Sound of Nây-ı Şerîf, Instrument of Ney (Ney: Turkish Reed Flute, Nay)." In that research, high-frequency sound vibrations from the Ney instrument, amplified with specialized equipment, were used to generate significant sound energy capable of altering biological barriers, such as the blood-brain barrier in Alzheimer's patients. This is based on the scientific framework of "Elmas’s Theory of Thermodynamics," which outlines an advanced approach to the theoretical application of a proposed fifth law of thermodynamics in medical science. Drawing parallels to this methodology, the "Medi-Ultrasound Eye-Tronic Method" applies a similar concept for cataract treatment. By using amplified high-frequency sound waves derived from the Ney instrument, the accumulated proteins in the lens can potentially be fragmented. Following this process, a specific solution or medication could further aid in dissolving and clearing these fractured protein particles. The efficacy of sound frequency modulation in health treatment has been discussed further in the author's article, "The Effects of Medicine and Music Therapy Practices on Human Health." This demonstrates how music therapy practices can have beneficial medical impacts across various conditions. In conclusion, this innovative method combines thermodynamic principles and acoustic energy to address cataract-related protein build up in the eye. By amplifying the frequencies of the Ney instrument with specially designed equipment, sufficient sound energy could facilitate protein breakdown and elimination within the lens. Not only does this approach offer a promising treatment option for existing cataracts, but it also holds potential as a preventive therapy to slow or inhibit cataract formation over time. Incorporating this method as a form of music therapy presents an opportunity to significantly enhance patients’ quality of life. [20], [40], [42]

Conclusion

“AI- Enabled Mobile Bio-Eye-Tronic System”:

This article presents the Mobile Bio-Eye-Tronic System, an innovative artificial vision system designed to assist individuals with blindness or low vision. The project is entirely original and unique, developed by the author of this article. A review of current advancements in bionic eye technologies reveals that no other system in the scientific literature employs a mobile phone camera paired with software to deliver results. This distinct aspect makes the bionic eye concept introduced here a ground breaking innovation. The cost of utilizing bionic eyes and artificial vision systems remains prohibitively high worldwide, including for individual patients. When such systems are imported into our country, expenses escalate even further. Moreover, the quality and visual capabilities of existing bionic eye systems vary significantly. Leveraging the infrastructure of existing mobile phones is, therefore, an exceptionally practical and economical approach to making bionic eye technology accessible to patients. By utilizing mobile phones as the foundation of this system, costs can be dramatically reduced compared to other solutions discussed in current studies. This affordability will enable more patients to acquire the technology easily, while notably improving their quality of life. The proposed Bionic Eye and Artificial Vision System will mark the first instance of integrating mobile phone infrastructure into its functionality. The system’s primary objective is to enhance visual performance while maintaining cost-efficiency. Furthermore, this initiative is part of a broader effort to develop a locally produced, nationally recognized system. From an economic perspective, such an advancement will significantly benefit our country while fostering local expertise. In conclusion, the proposed project is instrumental not only for improving human health but also for contributing to scientific, technological, and economic growth. It reflects a major step forward for our institution, Iğdır University in Turkey, by uniting the realms of health, science, and technology under a comprehensive and meaningful initiative. [20], [40], [42]

Figure 1: "AI- Enabled Mobile Bio-Eye-Tronic System" is a completely original and unique project, it is designed and named by "Emin Taner ELMAS", the author of this article. [42]

The Mobile Bio-Eye-Tronic System, an innovative artificial vision system designed for individuals with impaired or low vision, is illustrated in Figure 1. This ground breaking and unique project was conceptualized, designed, and named by Emin Taner Elmas, the author of this article [42]. The material and methodology for the Mobile Bio-Eye-Tronic System are outlined as follows: - Detection of light by a camera. - Amplification of the detected light energy using a transducer (such as an amplifier) and transmission to a retina sensor, where it is converted into electrical signals sent to the brain's vision center. - Processing of electrical currents in a processor, transforming them into recognizable signals. - Parameters including light amount, light density, wavelength, frequency, transmission speed, voltage, and current are integral to the project and can be compared for optimization. - Utilization of a mobile phone camera or integration of a vision system into mobile technology. - Development of computer modelling to support the project's functionality. [20], [40], [42]

The concluding points for the "Mobile Bio-Eye-Tronic System" project can be summarized as follows: - Variations in light energy will be explored to achieve different wavelengths, transmission speeds, frequencies, electric currents, and voltage values. - These resulting values will be systematically presented in the form of tables and graphs. - By correlating light density with the obtained frequency, wavelength, transmission speed, current, and voltage, comparisons with existing literature will validate their alignment with the signal values necessary for vision. - The overall system configuration will be designed and finalized. [1-54]

If we can establish a scientific analogy to solve the problem, it is possible to say that the mechanisms behind Alzheimer's disease and cataract formation in the eye appear to be fundamentally similar or nearly identical. Based on this observation, it can be inferred that sound energy techniques developed for treating neurological conditions such as Alzheimer's and Parkinson's could potentially be adapted to target the protein build up responsible for cataract formation in a comparable manner. Additionally, applying music therapy as a preventive strategy could slow down or inhibit cataract formation over time, offering a non-invasive preventive treatment option. Once cataracts have formed, sound energy in the form of ultrasonic waves—produced at higher frequencies—can be employed to break down the impermeable protein layer causing the condition. This fragmented protein layer could subsequently be dissolved using specialized medicated eye drops, enabling the treatment of cataracts without resorting to surgical intervention. The "Applied Medi-Ultrasound Eye-Tronic Method," devised by Emin Taner ELMAS and presented in this study, may represent an innovative and alternative non-surgical approach to cataract treatment within the fields of medicine and ophthalmology. [1-54]

The ELMAS Thermodynamic Theory [1] provides a valuable framework for understanding the medical treatment of patients through the use of various medications or drugs. Depending on the nature and dynamics of these interactions, treatment can lead to positive, negative, or neutral changes in energy and matter within cellular structures. According to ELMAS's Thermodynamic Theory, effective medical treatment requires precise regulation of these thermodynamic interactions, which can shift in positive, negative, or neutral directions. During these processes, energy and matter behave as dynamic parameters, comparable to "force" or "velocity," driving therapeutic bioprocesses. Throughout this systemic interaction, Total Energy and Total Mass across cellular boundaries aim to reach a state of balance. Essentially, the cumulative positive, negative, and neutral shifts in energy establish one equilibrium, while the corresponding shifts in matter form another interconnected balance within the human body's cells. [1]

This article delves into the functioning and potential applications of the bionic eye artificial vision system, which I have designated as the Mobile Bio-Eye Tronic system—a concept introduced during my earlier research. The primary focus is to examine how artificial intelligence can support and enhance this ground breaking technology. In this system, a built-in camera within the Mobile Bio-Eye Tronic captures visual data from the external environment, which is subsequently processed using AI. The processed images are converted from digital to analog signals, enabling effective communication with neural pathways in the brain. Through this mechanism, the brain is able to interpret its surroundings, effectively bringing the environment to life with the assistance of AI. For individuals with visual impairments, this process recreates a realistic visual experience, allowing them to perceive their environment similarly to watching a film that mimics natural vision. Cutting-edge image processing techniques will be employed to ensure the system's reliability and functionality, achieving the desired outcomes and improving the quality of life for its users. [1], [20], [40], [42]

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