R&D Item

2. Application of Awareness AI

1. Overview

In the R&D theme titled *"Development of Awareness AI,"* we aimed to implement unconscious human insight—based on the observation of bodily movement—into artificial intelligence. As a result, we successfully developed an AI system capable of analyzing physical actions such as gait and posture to predict individual issues and potential future disease risks.

However, there are inherent limitations to what the human senses can perceive. Subtle internal abnormalities or conditions that do not appear outwardly may be overlooked through traditional observation-based methods. To overcome these limitations, in the applied research phase of this project, we initiated the development of technology to visualize "invisible" biosignals, allowing Awareness AI to be used with greater depth and precision.

By integrating sensing technologies such as electromyography (EMG) and skin conductance response (SCR), we made it possible to read a person's internal physiological state from the outside. When these data streams are incorporated into Awareness AI, the system becomes capable of identifying problems and early signs of disease that previously could not be detected through observation alone.

To address the issues uncovered through this enhanced AI, we combine robotic intervention using the Robotic Nimbus system with medical treatments. This integrated approach aims to make progress in managing diseases previously deemed "difficult to treat," as well as to prevent the gradual and often unnoticed decline of physical function seen in conditions like frailty.

Our ultimate goal is to realize next-generation prevention and treatment: a future where conditions once considered untreatable become manageable, and where hidden problems can be brought to light before they worsen. We are also engaging in theoretical studies grounded in neuroscience to uncover why such changes and improvements are possible.

In parallel, we are working to connect these research outcomes with society at large. To communicate how science and technology are transforming our lives, we regularly host public seminars, where we present our research and future vision in clear, accessible language.

Through this integrated program of research and public engagement, our vision is to create a society in which Awareness AI can naturally detect physical irregularities in the course of everyday life and support both intervention and recovery. A new healthcare and lifestyle support environment—where humans, AI, and robotics coexist in harmony—is steadily taking shape.

2. Results in 2024

Figure 1 shows the results of visualizing internal muscle activity using a new muscle activity sensing system that we developed. This marks the first time in the world that deep-layer muscle activity has been directly visualized based on muscle activity measurements during natural, everyday movements.

This technology has been shown to produce significant therapeutic effects in cases of dystonia, a condition where conventional treatments have had limited success. Figure 2 presents an application example: a treatment case for a patient with writer's cramp. Writer's cramp is a disorder in which individuals can perform normal movements without difficulty, but when they attempt to write, specific muscles become excessively tense, making it difficult to move the hand properly. We analyzed in detail the abnormal muscle activation patterns that occurred at the precise moment the patient attempted to write, using our newly developed sensor and Awareness AI. As a result, we were able to identify the specific muscle groups causing the issue, and confirmed that targeted treatment using nerve block injections led to immediate symptom improvement.

This approach has been applied to over ten patients with writer's cramp or similar motor disorders, all of whom have shown positive treatment outcomes. This has made it possible to provide more precise interventions even for patients whose symptoms were ambiguous and difficult to diagnose or treat using conventional methods.

We are also working on movement support using the Robotic Nimbus system. Figure 3 shows the results of an experiment in which the system assisted Parkinson's disease patients in standing up. Parkinson's patients often experience a symptom known as "freezing of gait," where initiating movement becomes extremely difficult. By using Awareness AI to deliver stimulation from the robot at precisely the right moment, we enabled patients to stand up naturally and smoothly.

These achievements point to a new, personalized therapeutic approach for motor impairments that have not been adequately addressed by traditional rehabilitation or pharmacological treatments. We will continue to advance clinical application and real-world implementation of these technologies.

3. Future plans

To apply Awareness AI, we have conducted treatments for patients with dystonia and Parkinson's disease. Moving forward, we aim to embed these technologies into everyday life, creating systems that allow such patients to go about their daily routines without experiencing discomfort.
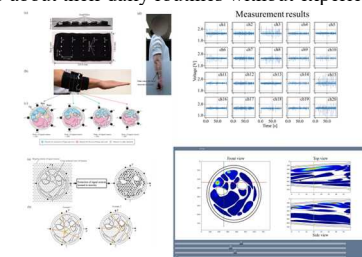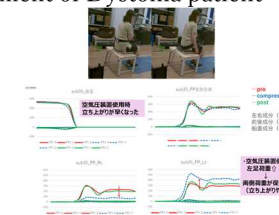

Fig 1 : Deep Muscle activity estimation

Fig 2 : Treatment of Dystonia patient

Fig 3 : parkinson disease treatment using Nimbus