

Flex AI: Smart Knee Rehabilitation

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Abstract

Elderly people ranging from 55 to 75 years old frequently experience painful knee problems due to aging and the weakening of muscles, yet many refuse surgery because of budget constraints, accessibility issues, and post-operative risks. To provide a non-surgical alternative that prevents these conditions from worsening, we developed an accessible exercise management solution using Micro:bit technology. Our system focuses on three specifically designed poses: seated knee extension (intended to alleviate knee pain), front-to-back leg swings (intended to improve balance to prevent accidents), and lateral leg raises (intended to support the hips to reduce force on the knees). By using Microsoft MakeCode and machine learning through the accelerometer, we trained the Micro:bit to recognize these movements with high accuracy. The innovation features an Artificial Intelligence Shoe, which is a slip-on footwear design that incorporates the Micro:bit and includes a remote control to allow users to toggle between modes and leg settings without needing to bend over. Our results show that the system effectively quantifies progress by displaying repetition counts on the screen and playing a melody after ten successful rounds to signal a transition to the next exercise. This design is particularly effective for seniors with limited mobility who require a stable and easy-to-use interface. The next logical step for this project is to expand development and ensure the product is accessible to elderly groups in rural areas, offering a cost-effective solution for overall health improvement and daily routine exercise without the need for expensive surgical initiatives.

Keyword: Knee rehabilitation, Elderly mobility, Micro:bit, Machine learning, Wearable AI footwear.