Smart Foot Device for Early Detection of Peripheral Neuropathy

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Peripheral neuropathy is a progressive condition that reduces sensation in the feet, leading to impaired balance, altered plantar pressure distribution, and increased risk of falls or injuries. Because symptoms develop gradually, early detection is often missed until complications occur. This project introduces a smart foot device designed to identify early signs of neuropathy by integrating sensors that measure plantar pressure, postural stability, and sensory response to vibration and electrical stimulation. The study involved 92 participants aged 40–50 years, including 42 clinically diagnosed neuropathic patients and 50 healthy controls. We tested the smart foot device to evaluate its ability to detect early functional changes by integrating measurements of pressure, balance, and sensory response. Statistical analysis was used to determine whether the combined sensor data could reliably distinguish neuropathic changes from normal patterns, demonstrating the effectiveness of multi-sensor integration for early detection. Results demonstrated clear differences between neuropathic patients and healthy individuals across all measured parameters. Patients showed altered plantar pressure distribution, reduced postural stability, and diminished sensory response, confirming that combined measurements provide a reliable method for early detection. The smart foot device proved to be a lightweight, non-invasive screening tool capable of identifying subtle functional changes before permanent nerve damage occurs. This approach highlights the importance of multi-sensor systems in enabling timely medical intervention, physical therapy, and lifestyle modifications, ultimately reducing the risk of falls and neuropathy-related complications.

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