Chapter 12
Development of an IoT-Enabled Wearable Device for Monitoring Elbow Movements in Children With Cerebral Palsy Using MAS, AMS, and QUEST:
Improving Quality of Life of Cerebral Palsy Children

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ABSTRACT

Cerebral palsy (CP) is a group of permanent movement disorders that significantly affect a child's ability to move and maintain balance and posture. Among the many challenges faced by children with CP, restricted joint movement, particularly in the elbows, severely impacts daily activities and motor development. The research proposes the design and development of an IoT-enabled wearable device aimed at assisting and monitoring elbow movements in children with cerebral palsy. The proposed solution integrates sensors such as accelerometers, muscle sensor, and flex sensors to capture real-time data on elbow flexion and extension. Tardieu, Modified Ashworth, Range of motion and Active movement scales are used for spasticity and movement assessment in order to provide thorough input. The sensor data is then transmitted to a cloud-based platform via WiFi. The proposed IoT solution provides real-time support for children with CP and offers a scalable platform for continuous improvement in therapeutic interventions.

INTRODUCTION

Cerebral palsy (CP) is one of the most prevalent motor disabilities affecting children worldwide, with around 2 to 3 children per 1,000 live births diagnosed with CP in India (Paul et al., 2022). It is estimated that over 25 lakh children in India are currently living with this condition. The disability is a neurological disorder caused by brain damage that primarily affects movement, posture, and coordination. Among the challenges faced by children with CP, restricted joint mobility, particularly in the elbows, significantly hampers their ability to perform essential daily tasks such as feeding, dressing, and writing. These impairments not only limit their independence but also affect their motor development and quality of life.

Traditional physical therapy approaches are commonly used to improve motor function. However, the methods often occur in controlled settings and lack continuous monitoring, which is crucial for the rehabilitation process. A review of interventions for children with CP shows that while physical therapy and motor learning approaches can be effective, their application is often constrained by the absence of real-time data monitoring and feedback (Novak et al., 2013). To address this gap, there is an increasing need for innovative technologies such as wearable devices that can offer continuous, real-time support to improve rehabilitation outcomes through sensors (Nascimento et al., 2020).

The research proposes the development of an IoT-enabled wearable device aimed at assisting and monitoring elbow movements in children with CP. The device incorporates advanced sensors such as accelerometers, muscle sensor, and flex sensors to

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