ABSTRACT

The design of a neck pressure and motion measurement system plays a critical role in evaluating vehicle occupant comfort, particularly under dynamic conditions. This project focuses on developing a hardware-based measurement system using load cells, permanently integrated into the neck section of a Smart Mannequin. The system is designed to detect axial pressure and calculate neck moment, with data processed and transmitted in real time to a web dashboard. Key components include load cell sensors, HX711 modules, Raspberry Pi 4, and motor springs for structural support. Programming was carried out in Python using the Thonny IDE. The system was tested in both laboratory and field settings, with field trials conducted using a four-wheeled military vehicle across various terrains at speeds ranging from 5 to 40 km/h. Laboratory results showed reliable accuracy, with sensor deviations ranging from 2 to 4 N when compared to a force gauge. Field tests confirmed the system's ability to record consistent pressure and moment data under realistic conditions, though absolute moment validation could not be performed due to instrumentation limitations. This system successfully meets its design objectives, including hardware integration and functional testing for comfort evaluation. The resulting prototype provides a foundational platform for future development of ergonomic assessment tools in vehicle environments.

Keywords: Force, Moment of Force, Load Cell, Ergonomics, Raspberry Pi 4, Vehicle Comfort