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IoT Device for Real-Time Recostruction of Head Accelerations in crashes: experimental validation.

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Objective
The primary objective of this study is to experimentally validate a novel Internet of Things (IoT) device designed for real-time assessment of head accelerations experienced by motorcyclists during crashes. By providing instant feedback on impact severity, the device aims to enhance rider safety and inform future helmet design improvements.

Methodology
A series of controlled impact tests were conducted in accordance with the ECE22.06 homologation standards, which outline strict requirements for helmet impact performance. The device, embedded within the helmet, collected linear and rotational acceleration data using multiple onboard sensors. Data were collected, processed, and then transmitted in real time to an external monitoring platform for analysis. Tests included varying impact velocities and strike points to simulate realistic crash scenarios. Calibration and validation were carried out by comparing the device's measurements against benchmark curves recorded from a validated Hybrid III headform.

Results
Results demonstrate that the IoT device reliably measures head accelerations with accuracy levels comparable to conventional laboratory equipment. In multiple impact conditions, the measurements remained within acceptable tolerance ranges. Furthermore, real-time data transmission proved to be robust, enabling immediate visualization of head acceleration profiles during helmet impacts.

Conclusions
The findings indicate that the proposed IoT device is a viable tool for real-time impact assessment. Its performance under homologation test conditions supports the feasibility of integrating such technology into commercial motorcycle helmets. Future work will focus on optimizing data analytics, refining the device's design for mass production, and expanding its application to other protective headgear used in sports and industrial environments.

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