Abstract—**This paper describes the design of a Weigh-in-Motion (WIM) system for vehicle load estimation using a single accelerometer sensor, thus overcoming the traditional WIM drawbacks. Traditional WIM systems based on complicated, multi-sensor configurations are usually heavy in installation efforts and maintenance costs. The here-introduced solution, on the other hand, exploits small and low-cost accelerometers, which measure pavement vibrations caused by passing vehicles. The data preprocessing was performed based on a moving average filter and a Butterworth low-pass filter to improve the signal quality. Peak detection was performed by using the Mexican-hat wavelet function, and a calibrated load estimation model was used in obtaining the axle and total vehicle weights. Experimental results are presented that demonstrate the system's capability in the estimation of vehicle loads at different speeds. For a truck with a GVW of 7500 kg, the system achieved total weight estimation errors of 18.33% at 10 km/h, 12.26% at 15 km/h, and 24.62% at 20 km/h. The results shows that single-sensor WIM systems have the potential to be an effective and low-cost alternative to traditional methods. However, the accuracy in load estimation is still dependent on speed. Future work will be directed toward calibration technique refinement, speed-related variation issues, and integration of multi-sensor setups to enhance performance and extend the application of the system to dynamic traffic monitoring.**