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**Paper Title:** SmartHub: an activity monitoring device for manual wheelchair users

**Abstract:** Manual wheelchair users rely heavily on upper body force generation for propulsion, and as a result, they are susceptible to upper extremity injuries. These injuries are often related to propulsion techniques and individual wheelchair configuration. In order to better understand how propulsion metrics such as stroke frequency, stroke length and push force relate to biomechanical injury, it is necessary to monitor this data on a device for an extended period of time. A clinically available device known as the SmartWheel can be used to generate a report that summarizes these metrics. However, this device has a number of limitations that prevent its use in longer term studies conducted in everyday use outside of the clinic. The SmartWheel is a standalone wheel, that is substituted for standard, original equipment wheelchair wheels, which includes a range of different sensors. However, this device is relatively expensive, requires significant and time-consuming modifications to the wheelchair in order to be used, and is suitable only for in-clinic use. We have developed a novel device, called the SmartHub, which is a low cost, unobtrusive activity monitor designed to collect and store or transmit wheelchair propulsion data. This device is approximately the size of a hockey puck, and consists of a WIFI-enabled microprocessor, nine-axis inertial measurement unit, rechargeable battery that can be easily attached to any diameter manual wheelchair wheel. The device collects a wide range of propulsion characteristics in real-time, which can be utilized to produce the metrics of interest. The SmartHub and the resulting information it can produce have the potential to allow the study and evaluation of these metrics with the goal of reducing upper extremity injuries for manual wheelchair users.

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