Digital Incentive Spirometer for the Treatment of Post-COVID Patients With Motivational Graphical Interface and Telemonitoring Support

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Post-Covid syndrome is a set of physical and respiratory symptoms such as fatigue, shortness of breath (dyspnea) and weakness of the respiratory muscles, which can affect up to 56% of people who have been through severe forms of covid-19, as thousands of patients seeking rehabilitation in respiratory physiotherapy. To support respiratory rehabilitation we developed a new multifunctional Digital Incentive spirometer capable of diagnosing respiratory muscle weakness, working as a manovacuometer, promoting exercises to strengthen the lung muscles and improve gas exchange, helping to recover the respiratory functions of these patients. Its operation is based on creating, through valves, a resistance in the inspiratory or expiratory phase of breathing. It has a motivational graphic interface with digital games that produces a playful environment for breathing exercises (game therapy). Using IoT technologies, the device was integrated with an Internet platform that allows the transmission and storage of data so physical therapists have access to their patients' data remotely. It was developed with a fluid flow sensor, pressure sensor and microcontrollers in a structure produced with a 3D printer. We investigated the technical validity of the new device by calculating the accuracy of the sensors, comparing their results with a reference device using simple linear regression, its usability with games and the efficiency in sending data to the internet. As a result, it was possible to build a device with 100% accuracy in respiratory pressure measurements, with a cost of only 3.9% compared to related commercial devices. We also succeeded in the integration with digital games and the internet platform.

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