

## **ACCURACY PULSE OXIMETER WITH BLUETOOTH TO ESTIMATE PERIPHERAL OXYGEN SATURATION CONTINUOUSLY DURING PERFORMANCE OF PHYSICAL EXERCISE AND VALID FOR DARK SKIN.**

### **Description**

This technology based on pulse oximetry makes it possible to obtain physiological parameters (heart rate and oxygen saturation) in real time and continuously, from the signals of the photoplethysmogram obtained by the emission of several LEDs at different wavelengths.

The research group is developing a pulse oximeter, in the form of a ring with Bluetooth, to determine the heart rate and oxygen saturation continuously, from these photoplethysmographic signals, even in extreme situations, such as during the performance continuous movement during physical exercise and in athletes with different skin colors and in people with respiratory diseases with low oxygen saturation.

### **How does it work?**



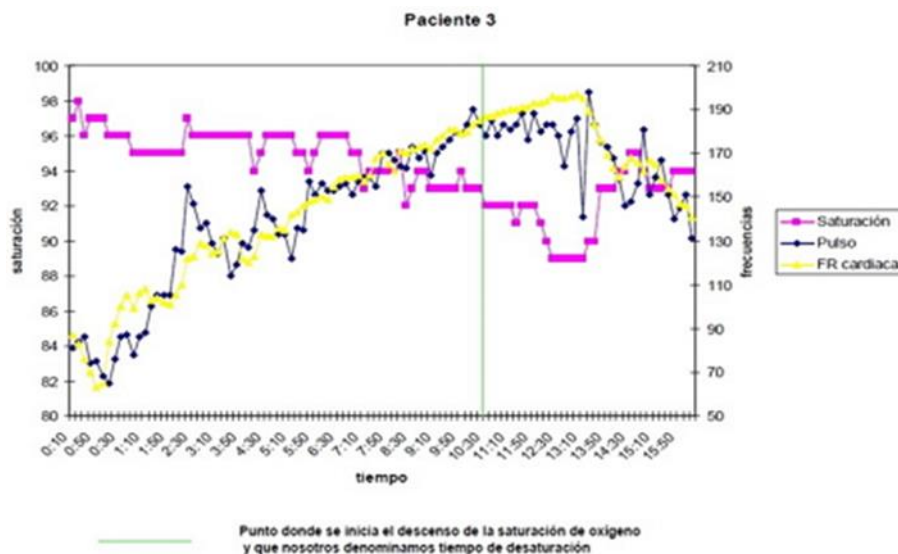
Patient/athlete performing stress test

Pulse oximetry estimates, through blood oxygen saturation ( $SpO_2$ ), the partial pressure of oxygen in the blood. This technique analyzes the pulsatile signal that is generated by the variation of arterial blood flow with the pulse generated by the heartbeat. It is continuously applied as a non-invasive technique, in the monitoring of patients throughout the anesthesia and intensive care process, in the control of newborns, evaluation and monitoring of chronic and nocturnal pulmonary disorders, and in sports medicine.

Recent studies have shown that the use of classic red and infrared emitters underestimates the level of oxygen saturation in the blood, for levels below 70%. The use of other wavelengths improves the measurement results at those levels. This problem is important in fetal monitoring, in sleep apnea studies, and in people who perform physical exertion, where these values are reached.

This technique, applied to the evaluation of the physical fitness of athletes and combined with ergometry, complements the stress test and constitutes an appropriate method for determining the cardiopulmonary effort limit, characterized by a significant drop in arterial saturation of oxygen. The study of the evolution of the oxygen saturation in the maximum effort by means of this type of oximeter together with the analysis of the correlation with the ergospirometric variables in different sports allows the knowledge of the evolution of the oxygen saturation during the exercise as a parameter to improve sports performance.

## Advantages



Data obtained from the athlete performing the stress test and the oxygen saturation values obtained.

This technology has proven to be robust and insensitive to movement artifacts, resulting in great utility and with greater precision than commercial oximeters in different settings, such as during intense physical exercise, with high heart rates, in people with dark skin and when there are low baseline oxygen saturation values (<85%). The results obtained during maximum effort tests, in cycle ergometer and treadmill, carried out on athletes of both sexes, demonstrate this. Pulse values derived with this novel photoplethysmographic technology match heart rate values measured by 12-lead electrocardiography.

With the new oximeter to apply to the sports field and to all types of athletes, better continuous recording results are obtained during a stress test than with commercial oximeters on the market, especially at high running speeds and heart rates above 150 beats per minute, in which there is movement of large muscle groups and in people and athletes who have dark skin colors.

## Where has it been developed?

The new method based on photoplethysmographic signals, and the new pulse oximeter designed to apply this methodology have been developed by a consolidated research group from the UCM 950056 - APPLICATION OF PULSE OXIMETRY IN SPORTS AND IN DIAGNOSTIC AID, this group has worked with Engineers and with other researchers such as the Pneumology Service of the San Carlos Clinical Hospital. Currently, this research has led to the development of a technological Start-up based in the Community of Madrid.

## And moreover

Manufacturers of medical and sanitary devices are sought, applicable to patients and athletes interested in improving the development of the pulse oximeter and/or commercializing it; especially companies that work with sensors for biomedical applications.

Impact:

Current marketed pulse oximetry products have many limitations and poor accuracy because:

- Does not measure well low levels of oxygen saturation (<90%) usually seen in respiratory diseases.
- Does not measure well at heart rates (HR) high or above (> 150 bpm)
- Does not measure heart rate well during intense movements.
- Darker skin colors interfere with the accuracy of the measurement.
- Inability to continuously measure oxygen saturation: studies show that in patients with respiratory diseases, they need continuous monitoring for monitoring of oxygen saturation values.

The competitive advantages that this device presents with respect to other similar products on the market are the following:

- 1.- Improved precision in measurements at low oxygen saturations.
- 2.- Improved precision in measurements at high heart rates > 150 beats per minute (bpm).
- 3.- Improved precision in measurements with intense movements, even with exercises carried out while running at more than 16 km/h.
- 4.- Improved precision in measurements with darker skin tones, where they clearly overestimate the oxygen saturation values.
- 5.- Continuous measurement during physical exercises to potentially detect sudden drops in oxygen saturation
- 6.- Bluetooth connection avoiding movement limitations due to cable connections or another system for obtaining results (probes).

Utilities and Clients:

Potential customers could be segmented into three large groups:

a.- Users who would use the device for medical purposes:

- 1.- Exercise prescription for people with heart and respiratory problems (especially post-covid 19 sequelae), these people, once they have recovered from their illness, must exercise regularly and precisely and the use of these devices, such as Comprehensive monitoring of your subsequent rehabilitation, adaptation of the exercise to your pathology and as a tool to help telemedicine
- 2.- Medical monitoring of patients with sleep apnea and other respiratory pathologies. Every time it is necessary a timely, precise follow-up and in a situation of both rest and movement of people affected or suffering from respiratory processes that require special follow-up to choose a specific therapeutic option.

b- Users who would use the device for sports purposes:

- 1.- Customers who can use the device for amateur and professional sports training, whose user volume has increased dramatically in recent years.
- 2.- Altitude training, Himalayanism. Hypoxia training. It is extremely helpful to monitor the oxygenation level (oxygen saturation) for people or athletes who perform exercises at high altitudes above 5000 meters of altitude. This monitoring of peripheral oxygen saturation helps us to know if oxygen supplementation is necessary at a certain level of altitude or as a predictor of the appearance of altitude sickness.
- 3.- Training in hypoxia, more and more athletes resort to this training system with the aim of improving their sports results. This training consists of training in hypoxic conditions in order to increase your red blood cells in a physiological way.

c- Users who would use the device for professional purposes: In this case we are referring to its use in combat aircraft where they need to implement precise oximeters that safeguard the safety of the pilot in combat aircraft, having to fly in hypoxic conditions.

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## Researcher in charge

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