MICRONEEDLE BIOSENSOR AND REMOTE MONITORING SYSTEM FOR HORMONE TREATMENT

TECNOLOGÍA PATENTADA

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RESUMEN

Researchers from the **University of Alicante** and the ***Technische Universität Dresden*** have developed a biosensor and an intelligent remote monitoring system that provides accurate, real-time information on hormone levels to patients and professionals. In addition, these data, through automatic processing techniques such as Artificial Intelligence or Machine Learning, provide patterns for better treatment of these pathologies.

The group is looking for companies interested in acquiring this technology for commercial exploitation through patent licensing agreements or to continue developing the technology.



INTRODUCCIÓN

Despite continuous medical and technological advances, there are today still many treatments that have not been addressed with remote monitoring due to the absence of reliable devices and smart health monitoring systems (SHMS) that provide accurate real-time information to the patient and the practitioner. This is the case for **hormones**, chemical messengers that travel through the bloodstream responsible for growth and development, metabolism, fertility, sex life and mood. Proper hormone balance is very important because, due to their high potency, a small amount can cause major changes in cells and even in the whole body. In fact, hormone deficiency or excess is linked to diseases with higher mortality and even birth rates because of its link to fertility.

It should be noted that the two leading causes of death in the European Union are **cardiovascular diseases and cancer**. In both cases, there are numerous studies that indicate their strong relationship with the levels of certain hormones and, therefore, the need for better control of their treatment. Another of the most relevant conditions affecting the European population is **infertility**, which in recent years has increased to very alarming levels, and which in most cases is related to imbalances in the sex hormones of both parents. Almost all infertility treatment methods involve hormone therapy and therefore, to avoid side effects caused by hormone injections, it is necessary to precisely control the level of hormones injected.

Hence, there is a need to improve the treatment of hormonal pathologies through **remote monitoring** of hormone levels over a certain period of time. These data, using Artificial Intelligence techniques, could be used to **predict patterns** in these pathologies and their **treatments**, and thus help healthcare professionals in their decision making about these diseases.

DESCRIPCIÓN TÉCNICA

The present invention offers a holistic solution for the improvement of hormonal treatments of diseases such as infertility, hormonal therapies, cancers of reproductive and sexual organs or cardiovascular diseases. Their features are detailed below:

1) Biosensor based on field effect transistors (FET) with microneedle array for continuous hormone monitoring.

The first novelty of the invention is a portable device equipped with a microneedle array biosensor for the detection of hormones in interstitial fluid. This minimally invasive device will allow continuous monitoring of relevant hormone levels over a certain period of time. It will also help to personalise hormone treatments and therapies based on the data collected by the biosensor.

2) A remote health monitoring system based on Digital Twins.

The second novel component of this invention is the implementation of an intelligent remote health monitoring system (SHMS) based on Digital Twins. This system allows modelling, simulating and providing a fast deployment of different remote health monitoring scenarios based on IoT medical devices such as hormone biosensor or any other health devices such as smartwatch, smartband, etc. The SHMS is based on HL7's FHIR health standard, for the definition of care plans for patients, and rapid integration with healthcare systems. It has a patient app that collects information from the sensors and also provides and collects the patient's treatment activities. Finally, it should be noted that the information collected by the SHMS is offered to doctors through a mobile app, for which an analysis of the data is performed based on artificial intelligence models that allow the detection of patterns in the treatments, and thus help optimise decision-making by doctors.

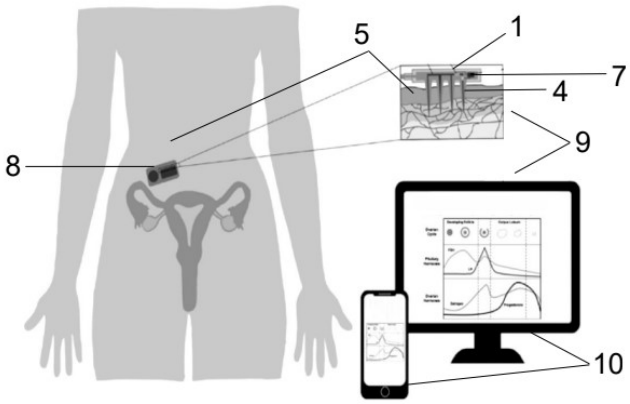


Figure 1: Elements comprising the invention: Biosensor (1), Microneedle array (4), Skin or tissue (5), Microcontroller (7), Adhesive patch (8), Biological sample control system (9) and Control unit (10).

VENTAJAS Y ASPECTOS INNOVADORES

MAIN ADVANTAGES OF THE TECHNOLOGY

The main advantages of this technology are as follows:

- It is a **portable and minimally invasive device**, integrated into an adhesive patch. In this way, the person does not have to prick themselves every time they want to take a measurement, thus improving the user's quality of life.
- The **remote and continuous monitoring** of hormone levels provides accurate **information in real time**, thus generating **alerts to warn the patient and the professional of variations**.
- This data collected by the biosensor will allow **personalisation of treatments and hormone therapies**.
- The semiconductor nanomaterials needed for biosensing can be manufactured in flexible polymer films. This results in **lightweight sensors that are more affordable and compatible** with the final handheld device.
- The nanoscopic dimension of the semiconductor material allows **high sensitivity** to chemicals.
- The electronic circuit is powered by a **battery or a wireless power supply system**.
- The information obtained can be viewed by medical staff remotely and via a mobile device such as a Smartphone or Tablet (control unit).

INNOVATIVE ASPECTS

The invention has several innovative aspects that are worth highlighting:

- The biosensor contains a reservoir with an opening in order to **deliver drugs more precisely** according to the clinical needs of the patient.
- The use of modelling and simulation techniques such as **Digital Twins** allows the prediction of a complete scenario of a specific treatment and decision making based on synthetic data from the simulator. In this way, the use of simulation would accelerate the collection of data before the scenario has been implemented, and also allow a first feedback from healthcare experts to the solution.
- The smart microneedle arrays with on-demand sample collection are obtained through **3D printing** using a photoresist.

ESTADO ACTUAL

It is currently under **development** in the **laboratory** but a prototype is planned for the next few months.

APLICACIONES DE LA OFERTA

It primarily targets the eHealth sector, more specifically **medical device manufacturing companies**.

COLABORACIÓN BUSCADA

Companies interested in acquiring this technology for **commercial exploitation** through patent licensing agreements or for further development of the technology are sought.

DERECHOS DE PROPIEDAD INTELECTUAL

This technology is protected by **patent application**:

- *Patent title: Microneedle biosensor and remote monitoring system for real-time hormone treatment.*
- *Application number: EP24382010*
- *Application date: 08/01/2024*

SECTORES DE APLICACIÓN (3)

Engineering, Robotics and Automation
Materials and Nanotechnology
Medicine and Health

IMÁGENES TÉCNICAS (1)

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