

Wearable and healthcare

UBIQUITOUS E CONTEXT-AWARE COMPUTING

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Introduction

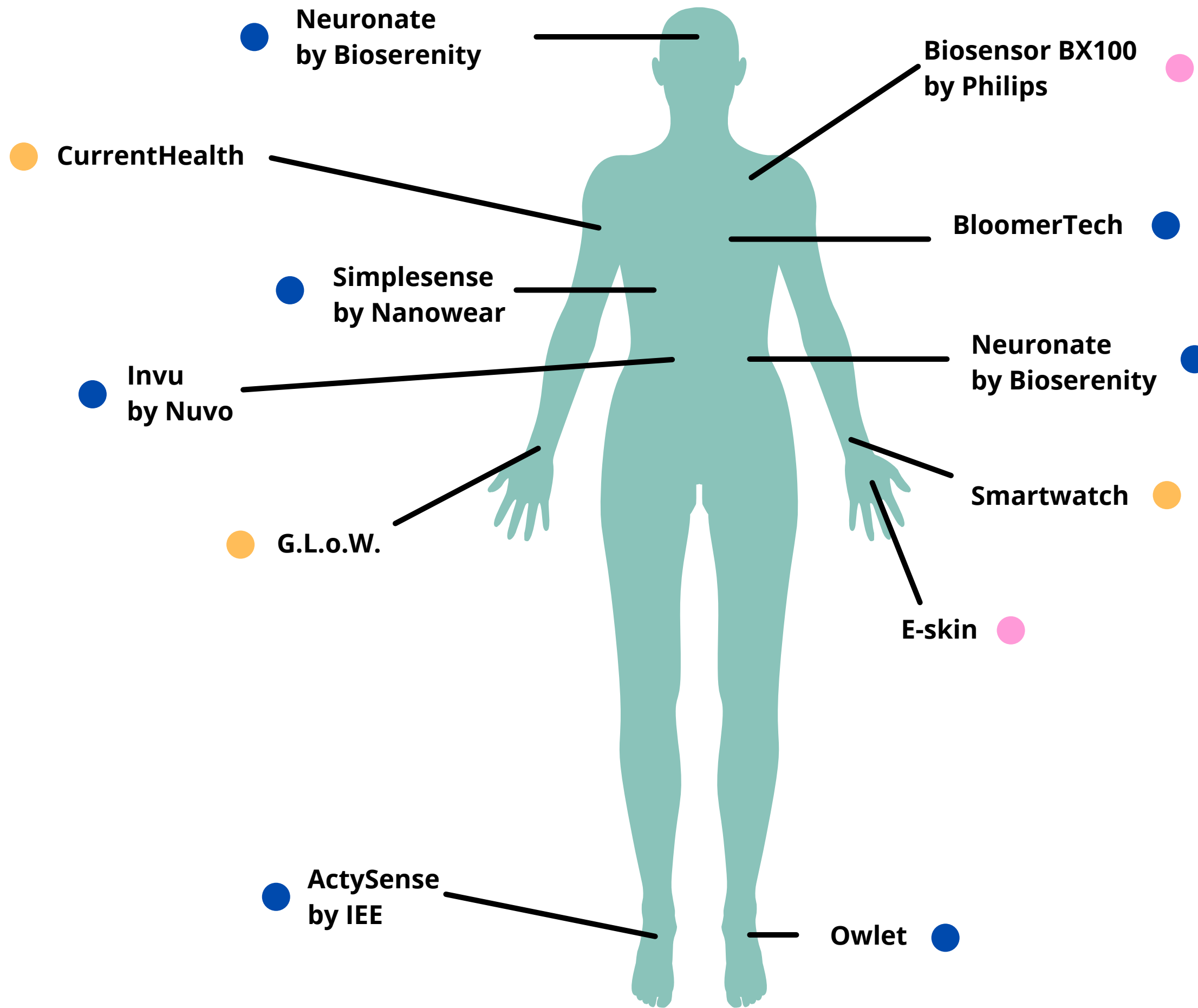
All the Wearable devices can be described as smart devices, associated to a downloadable application, that thanks to their sensors, help users to check their vital and health parameters to stay healthier.

Accessories can be considered the most diffused kind of wearable devices, because of their interconnectivity and practicality, they're equipped with sensors for biometric data tracking. Other types pick up physiological signals.

Advantages of a Wearable Device

- reduction of clinical error in the transcription of parameters
- makes your health monitoring easier
- reduces healthcare costs





- ACCESSORIZE
- CLOTHING
- SKIN

Accessories

They can be considered wearable devices, that look like accessories.

Thanks to innovation, users are beginning to be more and more interested to them.

Strengths:

- Aesthetic
- Technological progress

Advantages:

- Independence
- Interaction with the owner
- Tracking informations about his activities.





Omron Watches are designed for all health needs of the customers, which detect their health problems.

Heartguide, is a clinically validated to:

- portable blood pressure meter
- check heart's health
- physical activity
- sleep health





Garmin Watch, is a device that checks physical activities and health, that's why they're frequently used in sports.

- Garmin Connect connects it to an application downloadable on smartphone or a computer.
- Performance tracking for any objective and for any sport.





G.l.o.w. (Glucose Level on Wrist) is a sensorized cuff.

Diabetic patients can:

- keep constantly under control glucose levels in biological fluids, in a painless and minimally invasive way.

With the detection of the glucometer, it lights up 3 leds to signal:

- normality (white)
- hypoglycemia (blue)
- hyperglycemia (red).



current health

Wearable device capable of measuring various vital parameters:

- heart rate
- respiration
- oxygen saturation
- temperature
- patient mobility

It provides to the doctor real-time updates about their patients' health:

- immediate management of possible complications

Automatic learning:

- analysis of collected data and observation of trends over the time





Advantages:

- Reduced treatment/care costs
- Convenience (elderly)
- Doctors -> simultaneous monitoring of several people
- Precise and personalized care

Tablet for patients:

- educational content
- medication reminder
- chatbots for collection information on patients' symptoms



Clothing

Wearable technology will change the traditional diagnostic methods.

Benefits respect to the other one,:

- flexibility
- compatibility with large-scale computing

The healthcare wearable system must be: combined with the skin of the human body, consistent, durable and resistant to abrasion.

In the monitoring process, many different stimuli may be loaded on the detection device at the same time; therefore, the ability to distinguish between target and non-target parameters is necessary.



One of the main aspect of wearable technology is stretchability: high performance and elastic mechanical response are an ideal choice for the next generation of healthcare applications.

Good tensile properties make compliant contact between the device and the skin, with a dynamic complex structure and high spatial and temporal resolution, improving signal collection from the skin interface.



Neuronaute

Smart clothing system developed by BioSerenity for diagnosis and monitoring of patients with epilepsy in their own home.

Smart shirt and smart cap:

- biosensors that monitor physiological characteristics:
 - muscle activity
 - heart and respiratory rate

Data is sent to a smartphone app for analysis:

- warning sent to clinicians as soon as a seizure is detected:
 - advice on the correct procedures to follow -> no hospital clinic



Neuronaute

The system can be worn by the patient at home:

- collecting data for longer periods:
 - improve the diagnosis

Anonymised version of the data will be made available to medical researchers:

- to develop better understanding of the types of seizures patients suffer
 - identifying causes of sudden unexpected death in epilepsy





SimpleSense is an FDA cleared remote diagnostic platform.

It's a gender neutral and size adjustable sash that is worn close to the chest:

- monitors multiple patient vitals:
 - heart and respiratory rate
 - blood pressure
 - physical activity

Through nanosensors it captures over 120+ million patient data points per day.

AI-enabled real time analytics:

- reports for physicians:
 - to care for patients remotely





The sash communicates with an application installed on smartphone:

- records the wearer's activity:
 - each session is then saved and sent to the doctor

Freedom to recover from home.

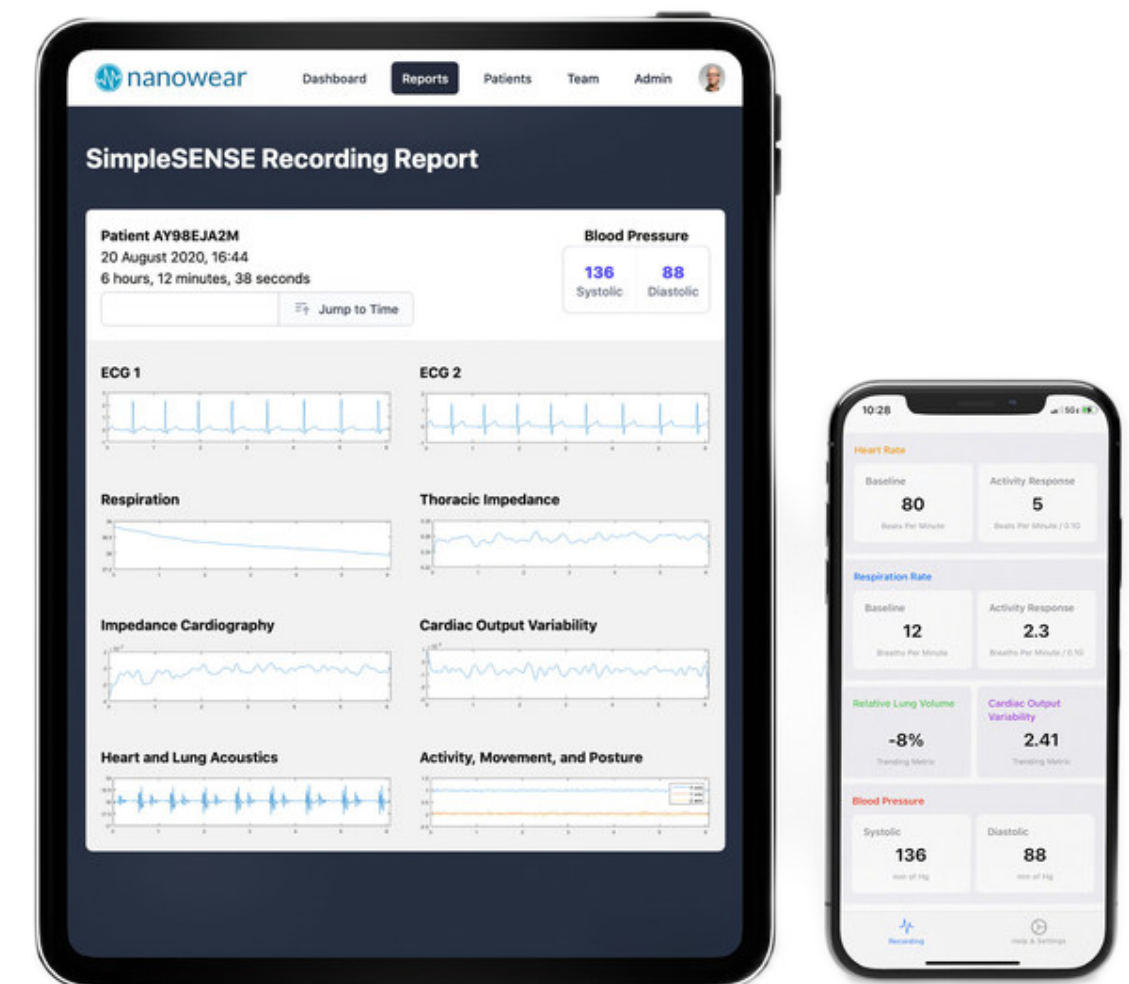
Gives providers insights on chronic conditions:

- to inform preventative healthcare
- to advise telehealth programs with accurate diagnostic data



Replacing multiple tools used in hospitals:

- providing physicians a real time in-depth analysis.





BLOOMERTECH

Amelia Bloomer:

- a woman's rights activist in the mid-1800s
 - opposed restrictive corsets
 - > encouraged women to wear loose-fitting pants (bloomers)

It's the world's first electrocardiogram device integrated into the bra.

Sensors and machine learning algorithms in the fabric of a bra:

- ECG,
- oxygen level
- body position and movement
- breath frequency
- heart rate
- body temperature





BLOOMERTECH

The data can be used directly from the application:

- the information can be shared with the doctor:
 - personalized assistance

Automatic learning:

- analysis of the data collected:
 - to help accelerate research focused on heart disease in women

Benefits:

- Invisible Technology
- Women-specific
- Remote patient monitoring
- washable and flexible fabric





IEE's smart footwear sensing solutions measure how the pressure is distributed on the sole of the foot/shoe when walking, running or jumping.

Wealth of information for athletes or rehab patients:

- measuring and tracking the right data helps:
 - boost sports performance
 - optimize podiatric medical monitoring
 - prevent injuries and asses risks for developping diseases early on

The data is then sent for analysis to a remote receiver.

- smartphone, smartwatch or computer



Benefits:

- Thin and bendable, non-intrusive printed electronics
- Accurate and reliable measurement and analysis for gait and posture, supporting
 - Clinical purposes: rehabilitation, diagnosis of lower limb problems, specific footwear design, ulcer prevention for diabetics, improved balance and confidence for elderly people
 - Sports: biomechanics, therapy, injury prevention, training
- Flexible, cost-efficient, can be custom designed for specific applications and offers various integration possibilities





Invu is an abdominal belt that, remotely and accurately records:

- fetal ECG (fECG)
- maternal ECG (mECG)
- maternal uterine activity (MUA)

It comprises a wearable sensor band with biopotential, acoustic and movement sensors.

An algorithm analyzes the data and delivers information to the mobile app:

- the mother can access to personalized insights
- all the data are shared with her gynecologist



Invu by nuvo™

The FDA approved Invu:

- after finding the device's accuracy and ease of use in a study of 149 people

It has the potential to:

- increase access to specialty care
- enhance patient experience in a way that is safe, cost-effective and risk appropriately

During the current COVID-19 pandemic:

- minimize unnecessary exposure





Is a smart sock that you can wrap around the baby's foot and track child's vital signs:

- heart rate
- oxygen level
- sleep quality
- sleep apnea monitoring

Alerts the parents if the baby's data deviates from the preset intervals:

- via smartphone app

It monitors up to the age of 5.

Can be integrated with a camera.





Prevent fear of SIDS (Sudden Infant Death Syndrome):

- infants may stop breathing during their sleep due to blocked regurgitation or something else and parents may not notice it in time.
 - the smart sock saved the lives of three children with respiratory failure

Integrated sensor for the wireless charging when not in use.

- the Base Station is the primary notification device

Durable, hypoallergenic, infantile use, BPA-free and lead-free fabric.



Skin

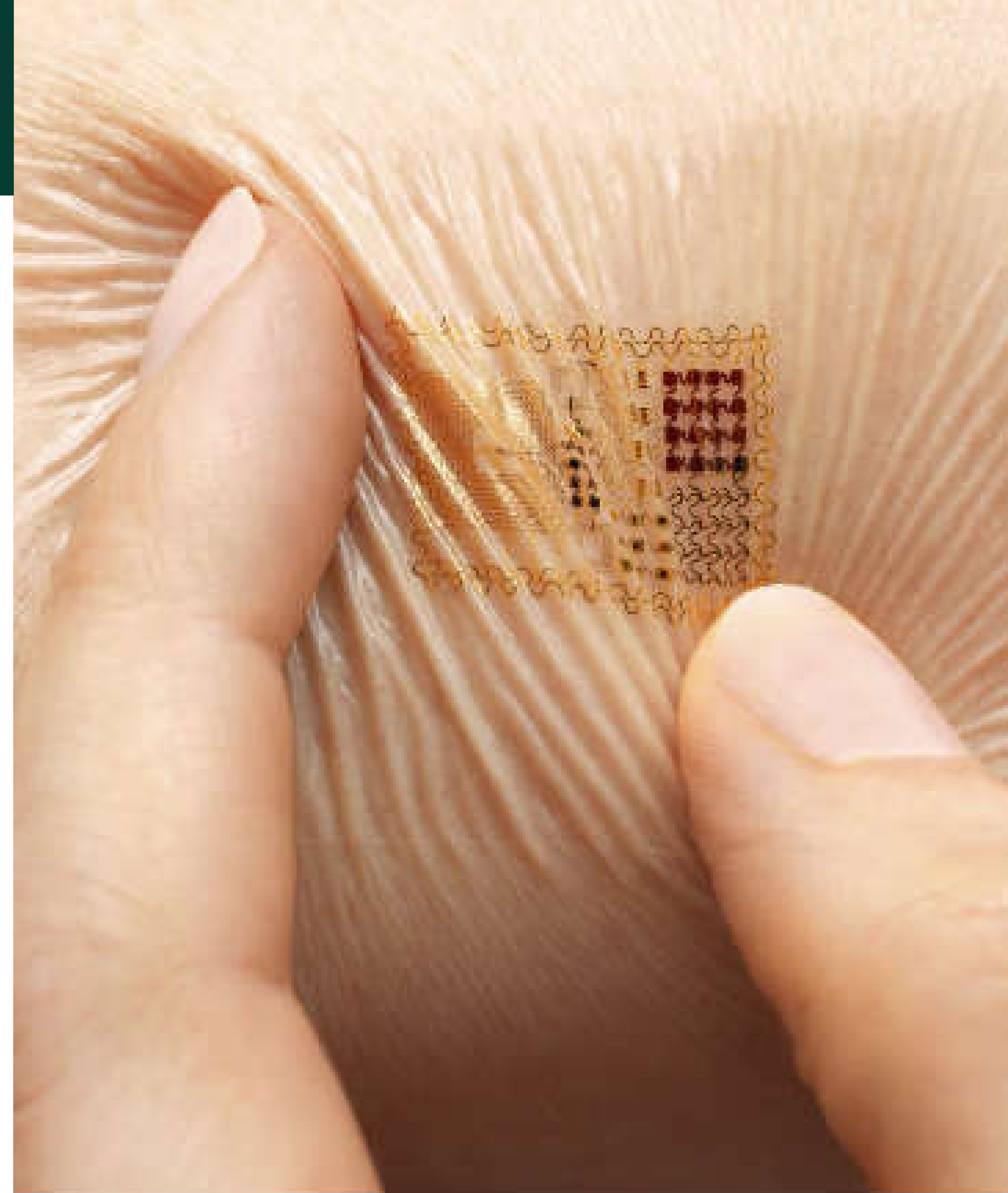
In order to produce a wearable sensing system suitable for personal health monitoring, the devices need to be adapted to the irregular structure of the human body.

It requires that:

- the thickness of the devices has to be as imperceptible as possible
- flexible and conformable.
- other important aspects are biocompatibility and biodegradability.

Wearable medical devices must be comfortable and avoid restrictions to daily activities.

Biocompatibility between the human body and wearable sensors is the key to avoid triggering an immune response.



E-skin

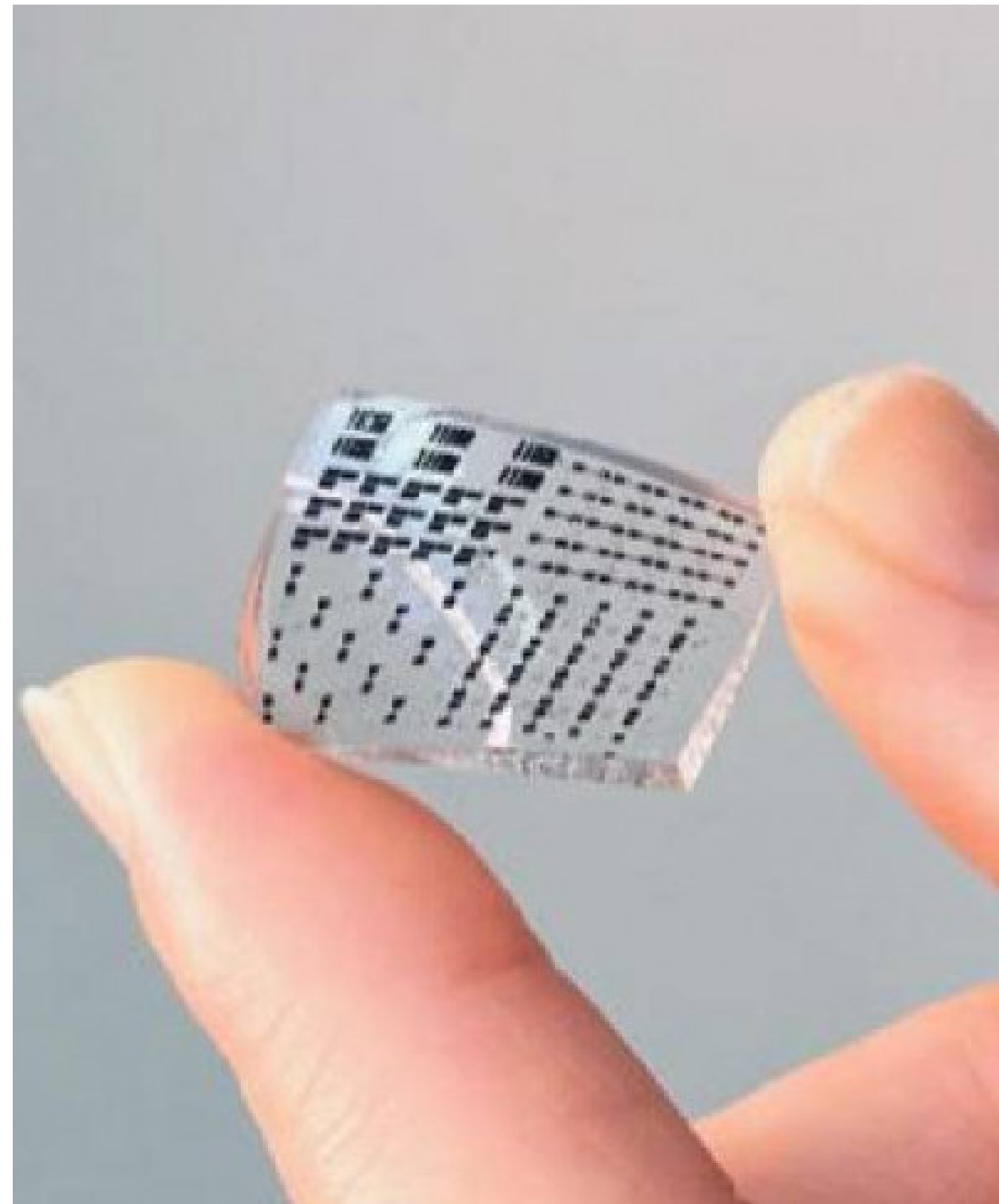
E-skin are wearable sensors, capable of detecting certain vital parameters such as:

- blood pressure
- body temperature
- heartbeat
- electrical impulses due to muscle movement

The biometric data are analysed directly by the device. Someya has developed a LED display to be worn on the back of the user's hand that will show the heart rate data transmitted by the e-skin in the form of large, easy-to-understand graphs.

Benefit:

- patients who need constant monitoring of their health condition
- monitor chronic diseases such as diabetes or heart failure
- detect early signs of illness.



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Biosensor BX100

The BX100 is a 5-day, single-use wearable patch:

- designed to be integrated alongside a scalable hub:
 - to monitor multiple patients across multiple rooms.

The BX100 collects, stores, measures and transmits respiratory rate and heart rate minute by minute.

The device requires no cleaning or charging.

The patients are free to move around the care unit or hospital.



PHILIPS

Biosensor BX100

Measures, records and transmits vital signs data:

- free time for more effective use of staff resources
- reduce errors caused by manual transcription

It is possible to continuously and remotely monitor patients:

- which has been especially important on the COVID-19 wards.
 - not possible to walk in and out of the patient rooms without protective gear



Conclusion

Body sensor network (BSN) and wearables are upcoming technologies for providing ubiquitous healthcare monitoring.

They allow a continuous management of patients under their natural physiological states.

We have to consider negative psychological effects: besides uncomfortability, users might feel that they have health problems when they wear body sensors, which further causes stress and other negative emotions.



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