

ABSTRACT

One of the greatest challenges that society continues to face is ensuring that everyone can be healthy. From the discovery of penicillin to breakthrough cancer treatments, new technologies make it possible for people to stay healthy. In this time of endless advancement, it seems that wearable technologies are the next step in the field. But new technologies often come with their host of issues, and wearables are no exception. In examining the various issues of wearables, we identified the design constraints related to invasiveness of biosensors, low power supply, signal noise, and transmission of data. Future development should be focused in these areas to make the devices as effective and safe as possible. Ultimately, every small technological improvement will bring about better quality of life for wearable healthcare patients.

OBJECTIVES

- Elaborate on types of sensors
- Identify challenges with wearable devices
- Discuss data processing and transmission

TYPES OF SENSORS

- **External** - These sensors are wearable on the outside of the body, such as in a wristband or behind the ear. These devices benefit from their ease of accessibility. Common applications are that of a heart rate monitor and a hearing aid.
- **Internal (Implantable)** - Typically placed under the skin, these sensors benefit from their more accurate and detailed vital data, often with constant monitoring. Implantable glucose monitors are a good example.
- **Multi-component System** - A combination of external and internal sensors, these systems gain the best of both worlds. An example is an advanced hearing aid that captures sound through an external sensor, then sends that data to an implanted device that delivers electrical impulses to the inside of the ear.

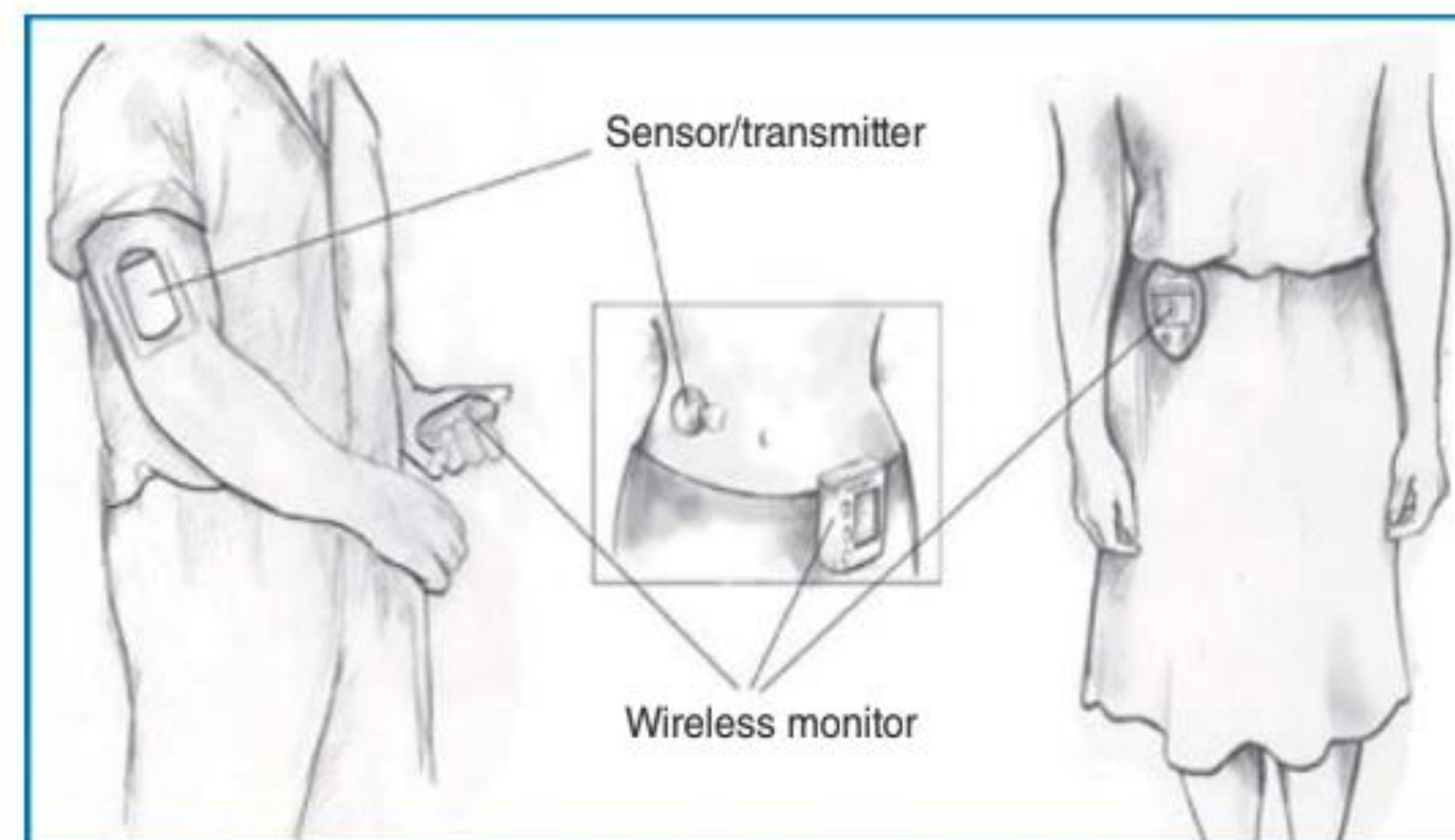


Figure 2. Example of a Multi-component System

CHALLENGES WITH WEARABLE DEVICES

- **Biosensor invasiveness** - Biosensors are often invasive for measuring bodily functions such as pricking fingers to obtain blood samples
- **Power Supplies** - Power supplies for many devices are often low in charge and need to be recharged 2 to 4 times a day on average
- **Device Noise** - Some wearable devices produce noise constantly, which can be an annoyance to the user.
- **Data Privacy** - By keeping a standard for each type of device, violations in data ownership and accessibility can be kept to a minimum.
- **Biocompatibility** - Tissue damage is caused by overheating and overloading the nervous system with electric impulses.

DATA PROCESSING & TRANSMISSION

- **Noise Filtering** - Before transmission of data is obtained from sensors, noise must be filtered by a variety of techniques.
- **Data Transmission**
 - Long Range Wireless - Cellular networks can be used for long range wireless data transmission, but given battery constraints, it is often more practical to use a short range wireless protocol to transmit the data to another device such as a smartphone.
 - Short Range Wireless - A short range wireless protocol can be used to exchange data with another component in the system. Wireless protocols designed to sacrifice data speed for the sake of lower energy consumption, such as Bluetooth Low Energy, are typically ideal.
- **Security** - At any stage of data transmission, security must be considered in order to maintain the privacy of the medical data.
 - Most short range wireless protocols have security that provides the capability of generating secure keys and encrypting messages.

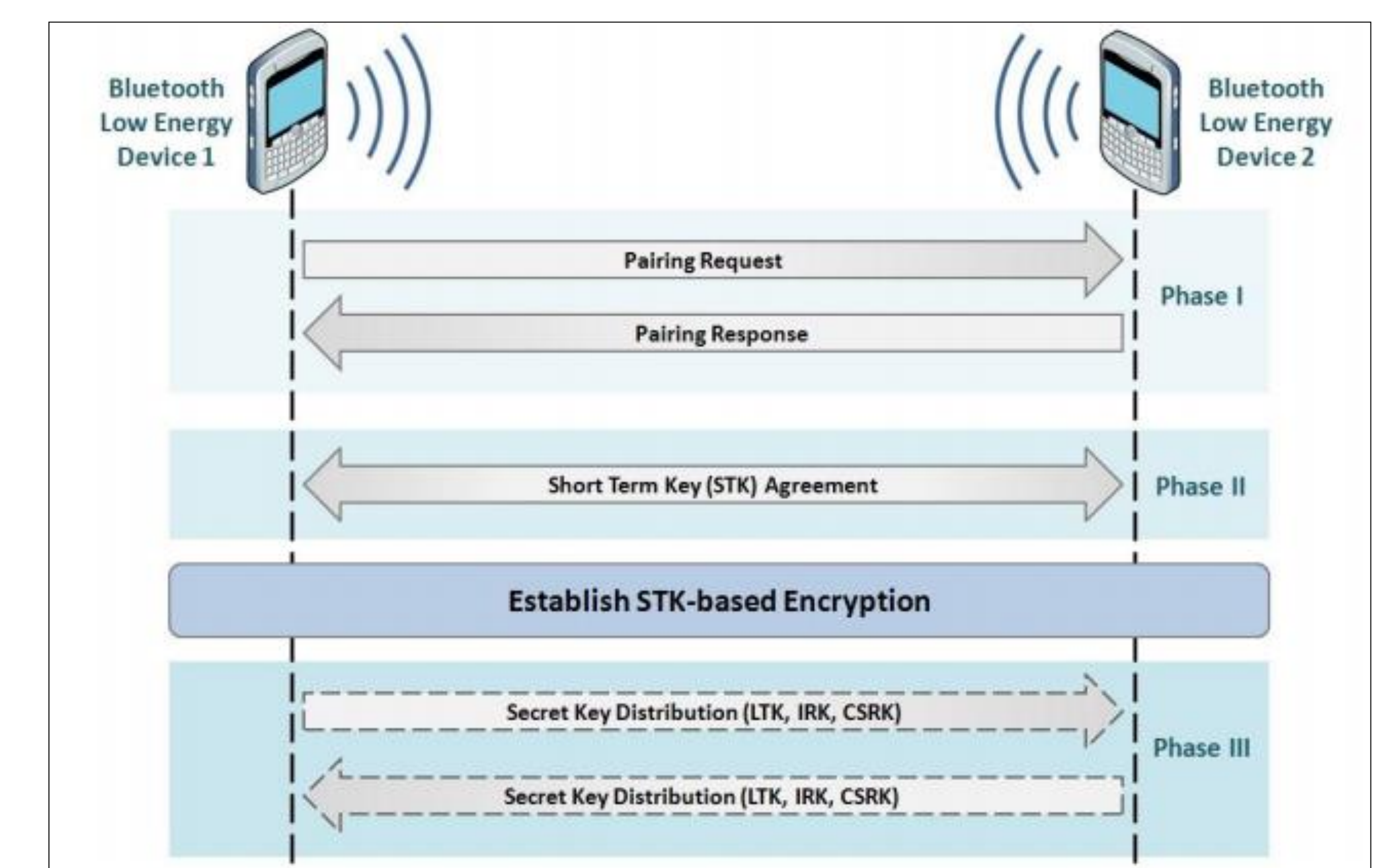


Figure 3. Bluetooth Low Energy Security

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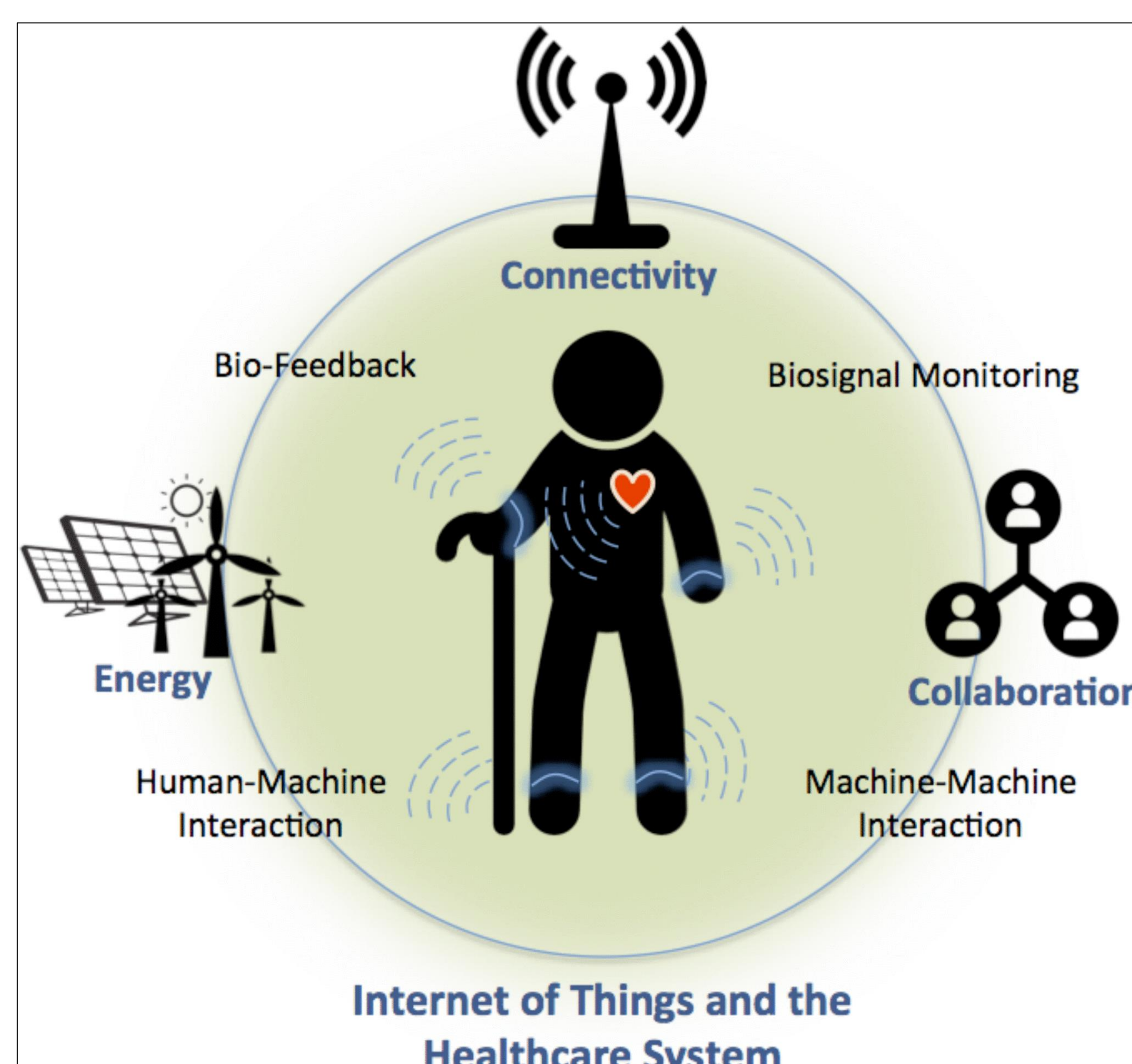


Figure 1. Cycle of Data from a Wearable Device