

Components of wearable Systems.

The main components of wearable devices are as follows

1. Control

Wearable-specific microcontrollers are small, so as to be comfortable and discrete. On the other hand, the distinctive shapes and colors can function as a decorative element. Several of the boards available are hand-washable (minus the power source). Read the documentation carefully.

2. Input/Output

In place of pins, these boards have metal eyelets which you can loop conductive thread through to sew soft circuit connections. Some boards also have snaps — or eyelets large enough to solder on snaps — for easy removal.

3. Conductive Textiles

A material containing metals, such as silver or stainless steel, through which an electrical current can flow is said to be conductive. Wearable systems can make use of these materials in a variety of ways, such as:

- Thread for making circuits
- Fabric for capacitive touch sensors
- Hook-and-loop for switches

4. Sensors

Sensors gather information about the environment, the user, or both. Examples of the former include light, temperature, motion (ACC), and location (GPS). Examples of the latter include heart rate (ECG), brain waves (EEG), and muscle tension (EMG). A few wearable microcontrollers have basic sensors onboard. Other manufacturers offer a range of external sensor modules that connect to the main board.

5. Power

When scoping out a wearable design one of the first things to consider is the power requirement. Do you just want to illuminate a few LEDs, or do you want to run a servomotor? Boards with an integrated holder for a lithium coin battery are nice for low-power projects that need to be self-contained. However, boards with a standard JST connector (with or without a circuit to charge LiPo batteries) are more versatile.

6. Actuators

One generic way to describe a wearable system is: In response to X, where X is the input from a sensor, Y happens. Actuators such as LEDs, buzzers or speakers, and servomotors are what make things happen.

7. Networking

To communicate with smart devices, the internet, or other wearable systems, you need wireless connectivity. In addition to Wi-Fi and Bluetooth, wearable-friendly options include:

- BLE, which has lower power consumption than classic Bluetooth, a range of 50m, and a data transmission rate up to 1 Mbps
- NFC, a radio frequency field with a range of approximately 20cm and data transmission rate up to about 400 Kbps

Types of Wearable Systems

1. Smartwatches:

These days, the watches are tech-enabled. They double up as a fitness tracker, and sleep monitor in addition to being the classic time-keeping device. Smartwatches provide us with many other features including enabling us to make & attend phone calls and check messages. Some watches have the feature of playing FM radio or audio & video files with a Bluetooth headset. They generally connect to the smartphone via an app and act as a supporting device. They are often referred to as a ‘Wearable

Computer' on your wrist because of the bundle of features that can use through the touchscreen.

2.FitnessTrackers:

Fitness Trackers are among the wearable technology devices wearable on the wrist. Fitness trackers were primarily launched to perform the function of pedometer, i.e. counting the number of steps but they have evolved to become an overall health monitor since then. They perform various functions including tracking your heartbeat, monitoring your sleep, calories burned, and other metrics. They share the data to the app on the smartphone. In toto, they make a perfect health tracker. Some devices are enabled to regularly share the information on the metrics of the wearer to their physicians to keep them informed and help early detection of any issue.

3.SmartJewelry:

Jewelry no more acts like pieces of ornaments on your neck or hand, they have become smart. Smart Jewelry are those wearables like necklaces, wrist bands, bracelets, or rings that are tech-enabled to help you track your steps, track monitor your heartbeat & sleep, and some even notify you of incomingcalls.

4.GameSimulators:

The rise of VR in gaming has given rise to many wearable devices that simulate an environment and make the experience more realistic, engrossing, and adventurous. The devices include VR Headsets (also called Head-Mounted Displays or HMDs) that create a visual simulation and bands that come with built-in sensors to detect your movements. These bands enable you to control your movements through hand

gestures.

5.SmartClothing:

The advancement of technology with IoT has fostered many inventions including Smart Clothes. Smart clothes are also popularly known as E-Textile as they come integrated with electronic devices that measure the health metrics of the wearer. Smart clothes help measure health-related aspects like heart rate, respiration rate, sleep, the body temperature, and provide you with that information. Smart clothing also includes smart shoes that examine your health, steps, fatigue, and collect other metrics to help you improve health and prevent injury.

6.SmartGlasses:

Ranging from simple smart glasses that are equipped with Bluetooth wireless music and hands-free calling to the glasses that can live stream videos to take photos, to advanced smart glasses that are AR-enabled to give you an immersive experience, these smart glasses are the of eyewear. Smart glasses can enable the user to read text messages and reply to them hands-free. Smart glasses by some companies are equipped with features like internet access and browsing through voice commands.

7.HeartbeatTrackers&BloodPressureMonitors:

There are fitness trackers for a specific use case like monitoring the heartbeat or regularly measuring the blood pressure. These devices help track the metrics among the people who suffer from related diseases. The fitness trackers record and provide the measurements to the wearer regularly. Some devices are enabled to share the data with the physician.

8.SmartEarbuds:

New to enter the wearable technology market are earbuds. Though Bluetooth earbuds are existing for a while now, they aren't considered among wearable technology because they do not collect and send data. But some companies are making earbuds smart. Smart earbuds have a built-in gyroscope, GPS, and compass. The sensors in the earbuds relay the information to the smartphone, which enables it to know your direction and movement. Hence, the smart earbuds are equipped to provide directions in real-time.

9.SmartContactLens:

Smart Contact Lens is among the recent inventions made possible with IoT. The smart contact lenses currently available in the market are helpful for medical reasons. It helps monitor eyes for various diseases like Diabetes, Glaucoma, and cataracts. It helps in the treatment of farsightedness. Apart from medical reasons, some companies are working on smart contact lenses that are AR-enabled, work on solar power, and capture and store images and videos. Smart lenses are among the implantable devices.

Applications of wearables

Currently other applications within healthcare are being explored, such as:

- Applications for monitoring of glucose, alcohol, and lactate or blood oxygen, breath monitoring, heartbeat, heart rate and its variability, electromyography (EMG), electrocardiogram (ECG) and electroencephalogram (EEG), body temperature, pressure (e.g. in shoes), sweat rate or sweat loss, levels of uric acid and ions – e.g. for preventing fatigue or injuries or for optimizing training patterns, including via "human-integrated electronics"
- Forecasting changes in mood, stress, and health
- Measuring blood alcohol content

- Measuring athletic performance
 - Monitoring how sick the user is
 - Detecting early signs of infection
 - Long-term monitoring of patients with heart and circulatory problems that records an electrocardiogram and is self-moistening
 - Health Risk Assessment applications, including measures of frailty and risks of age-dependent diseases
 - Automatic documentation of care activities
 - Days-long continuous imaging of diverse organs via a wearable bioadhesive stretchable high-resolution ultrasound imaging patch or e.g. a wearable continuous heart ultrasound imager (potential novel diagnostic and monitoring tools)
 - Sleep tracking
 - Cortisol monitoring for measuring stress
 - Measuring relaxation or alertness e.g. to adjust their modulation or to measure efficacy of modulation techniques
- **Epidermal skin technology.** According to Science Daily, the Terasaki Institute for Biomedical Innovation invented wearable electronic skin for monitoring health. A next-generation of wearables, this ultra-thin e-skin patch can be attached to the wearer's chest area along with a small wireless transmitter by using water spray and can be worn for up to a week. It is sensitive enough to pick up and record electro signals, such as heartbeats and muscle movements, which can be sent to healthcare providers via the cloud so they can monitor the user's vitals remotely. This powerful wearable is a steppingstone for monitoring chronic illnesses such as heart failure and diabetes.
 - **Health monitoring.** People use wearable technology to track and receive notifications for their heart rate and blood pressure, watch their calorie intake or manage their training regimens. The COVID-19 pandemic boosted the use of wearable technology, as consumers gained a broader awareness of personal hygiene and taking

precautions to prevent the spread of infections. Apple, for instance, updated its Cardiogram app by introducing a new sleeping beats-per-minute feature that monitors heart rate fluctuations for COVID-19 patients.

- **Entertainment and gaming.** The gaming and entertainment industries were the first to adopt VR headsets, smart glasses and controllers. Popular VR head-mounted displays, such as Oculus Quest, Meta Quest and Sony PlayStation VR, are used for all types of entertainment purposes, including gaming, watching movies and virtual traveling.
- **Fashion and smart clothing.** Clothing known as smart clothing, or intelligent fashion, has been gaining wide popularity over the past few years. Smart jackets, such as Levi's jacket made with Google's Project Jacquard technology whose threads are composed of electrical fibers, enable the wearer to answer calls, play music or take photos right from their sleeves. Smartwatches, wristbands, smart shoes and smart jewelry are also popular examples of wearable technology.
- **Military.** These wearables include technology that tracks soldiers' vitals, VR-based simulation exercises and sustainability technology, such as boot inserts that estimate how well the soldiers are holding their equipment weight and how terrain factors can affect their performance.
- **Sports and fitness.** Sports use wearable athletic devices that are either built into the fabric of the sports apparel or are incorporated into sports equipment, such as bats and balls. The GPS and Bluetooth-linked devices relay real-time data to coaches for analysis through connected electronic devices such as laptops. Besides wearable athletic devices, familiar wearable technology such as Fitbit, Apple Watch, Garmin, Samsung Galaxy Watch and Polar are

used extensively to track various areas of the player's health and performance metrics.

Advantages of Wearable Technology

- **Rapid data results can help drive improvements.** Having immediate data to make decisions and drive improvements may be helpful, rather than waiting for more formal or detailed assessments.
- **Detailed data can supplement loss analysis and loss trends.** Additional data can help identify specific trends in your claims history.
- **Can help build a business case for senior management.** It can be challenging to help senior management make decisions or determine if some of your funding should be spent on improvements. The data from wearable technology devices can help support your business case for that spend.
- **Data from wearable sensors offers promising job risk analysis and evaluation opportunities for safety and ergonomics practitioners.** Most ergonomic assessments or evaluations require additional time to observe and manually collect data. Having instant data can save time and expedite ergonomic assessments or evaluations.
- **Enhance employee wellness programs.** More organizations are starting to promote wellness programs for employees. Some wearable technology devices can assist with easily tracking wellness program data that could supplement or support your efforts.

Disadvantages of Wearable Technology

- **Requires a time commitment to review and analyze data.** A team or committee may need to review the large amount of data that is generated from the devices.
- **Requires financial commitments and planning.** You may need senior management or finance team approval prior to the full implementation stage. The cost of wearable technology depends on how many employees and locations are involved.
- **Devices could lead to distraction.** For many employees, wearing this device for an entire shift can be distracting, especially if the device has haptic feedback or vibration reminders.
- **Data security and privacy could be compromised with legal, financial, and personal consequences.** An information technology (IT) department will need to ensure the data generated from the devices is secured for authorized individuals and ensure proper consent is obtained from each individual whose data is being collected.
- **Devices could lead to over-trust or under-trust.** This could be challenging when reviewing all the data to determine realistic trends. Sometimes this results in trusting or not trusting all the reviewed data before making any decisions or improvements.