

## SMART HEALTH BRACELETES

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**Annotation.** Smart health bracelets: a fashion accessory or an invention of the future? In this article you will learn useful information about the history of the appearance of smart health bracelets, the principle of their operation and additional functions. The article also includes a study of the popularity of these gadgets and a list of criteria for choosing a smart health bracelet.

**Keywords:** Smart Health Bracelets, technology, sensors, smartwatch, invention, health.

**Introduction.** Nowadays, smartwatches (or fitness bracelets) have become a popular accessory among people of different ages.

Smart Health bracelet (activity tracker, smart bracelet, fitness tracker, etc.)– is an electronic device that helps to monitor certain types of activity, such as running, walking, distance, sleep quality, to analyze pulse rate, blood pressure, etc.

**Main part. The history of Smart health bracelets and its development.** The history of the appearance of the first full-fledged health bracelet began relatively recently, it combined a heart rate monitor from Polar, a pedometer and an interactive application from bicycle computers. In 2011, Jawbone released the world's first Jawbone UP bracelet, the functions of which were very extensive: calorie counter, statistical data maintenance, vibration sound during notification. But, unfortunately, the first batch of goods was unsuccessful, the company eventually suffered heavy losses. Competitors took into account the mistakes of the predecessor, introduced new functions. Now the manufacturers of fitness bracelets are large companies producing mobile devices, operating systems and sport goods [1].

**The principle of operation: the main sensors and their functions in smart health bracelets** [2,3]. An accelerometer (G-sensor) is a device that determines the acceleration of an object in space. Thanks to the accelerometer data, the fitness bracelet counts the number of steps taken and the speed of movement. Fitness bracelets are equipped with three-component accelerometers that track acceleration along three coordinate axes. The accelerometer built into the fitness tracker determines whether the owner's hand is at rest or moving with a certain acceleration. Data on the acceleration of your hand movement, that is measured by the accelerometer, is transmitting to the fitness bracelet's microprocessor, where they are processing.

A gyroscope is a device that tracks changes in the position of an object. GPS sensors are embedded in the bracelets to accurately calculate the speed of movement and the distance traveled. Thanks to the gyroscope, the microprocessor of the smartwatch is able to recognize not only walking or running, but also other physical activities.

Heart rate monitors are devices that determine the heart rate per unit of time. The technology by which the heart rate monitor works is called photoplethysmography. It involves the use of green LEDs that emit light and detectors that register the level of its reflection. When the heart contracts, blood pressure increases and capillary blood flow increases. As a result, more light emitted by the LED is absorbed, which is what the detector registers. Based on the information received, the pulse is determined.

A fitness bracelet with pressure measurement determines pressure by mathematical analysis, taking into account data on the pulse wave propagation speed, wavelength, pulse, ECG, etc. Special sensors consist of piezoelectric elements that installed in fitness bracelets - they generate electricity under the influence of the pressure exerted on them. Thus, the pulse wave from a person's wrist is converted into electronic signals of the appropriate magnitude, which are sent to special software.

Modern watches with altimeter function allow their owners to know exactly the height at which they are located. The sensor of the device reacts to changes in atmospheric pressure, showing the

corresponding data.

The function of monitoring the number of calories burned. Physical activity indicators are calculated based on accelerometer data. The main indicator of movement is the number of steps taken, the data about which is transmitted to the mathematical model. Some fitness bracelets also take into account the type of physical activity. Indicators of physical condition allow you to more accurately determine the energy costs of the owner of a fitness bracelet. These indicators include: pulse rate, blood pressure, blood oxygen saturation level. Anthropometric indicators are set by the user himself in the fitness bracelet application.

Fitness bracelets use 2 sensors to monitor sleep phases. It is thanks to the heart rate monitor, which monitors the heart rate, and the accelerometer, which detects the slightest movements of the owner, it is possible to monitor the change of sleep phases, as well as monitor night awakenings.

Bracelets with ECG measurement function. An electrocardiogram (ECG) is an examination that reads the duration and strength of electrical signals that occur during a heartbeat. During an ECG, electrodes are used to measure the electrical activity of the heart.

There are fewer electrodes in smart health bracelets than in medical devices. To do an ECG, you need to put one hand with the watch on the table, and put the second finger on the wheel and wait for the watch to take readings.

The heart rate variability indicator helps to determine the stress level - the interval between heartbeats. Based on it, "smart" bracelets report the level of stress. Variability is influenced by age, body position, time of day, health status and emotional, physical and mental experiences.

**Additional features.** Smart watch is the result of combining a health bracelet with a watch. They connect to a smartphone using Bluetooth, have touch screens, can perform additional tasks using software, such as: controlling a music player, using a calculator, voice recorder, flashlight, Internet browser, taking photos and videos, and more [4].

When the phone is connected, users can receive notifications on the watch from their smartphone. Most models of smart watches have such a function as a "smart alarm clock". It allows you to identify the most appropriate moment to wake up by controlling the change of sleep phases. Recently, more and more smartwatches are being released with the ability to make contactless payments using the built-in NFC chip.

Existing measurement errors of devices and its reasons. Errors in the measurement of human physical parameters may occur due to the following sources of interference [5]:

1. External lighting from the sun or lamps. Some of this light may fall on the photodiode, introducing distortion.
2. Motion-related interference- the sensor may lose the pulse wave and clings to another rhythmic signal caused by steps.
3. Skin color, tattoos, hair, tan. All this also has a certain effect on the absorption and reflection of light emitted by LEDs.
4. Location of the sensor. There are a lot of sources of optical noise on the wrist (muscles, tendons, bones).

**Important Criteria for Choosing Smart Health Bracelets.** When choosing a smart bracelet, you should pay attention to the following criteria [6]:

- screen – the presence of the display and its characteristics;
- functions –the necessary options should be selected taking into account personal preferences and your lifestyle;
- accuracy - this parameter depends on the type of sensors;
- protection from external factors - dust, water, shock;
- battery life and charging speed;
- synchronization with equipment;
- complete set.

**The Survey of BGUIR Students.** A survey of BSUIR students showed that 35% of students in group 111801 use smart bracelets, from which 77% of their gadgets contain functions that help to track physical health.

The following purposes of using these bracelets that were identified, are shown in the figure 1. Rating of the most popular features in smart health bracelets is shown in the figure 2.

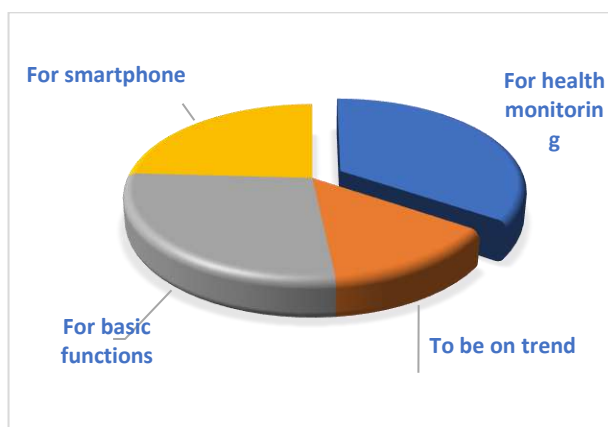


Figure 1 - Purposes of using smart bracelets

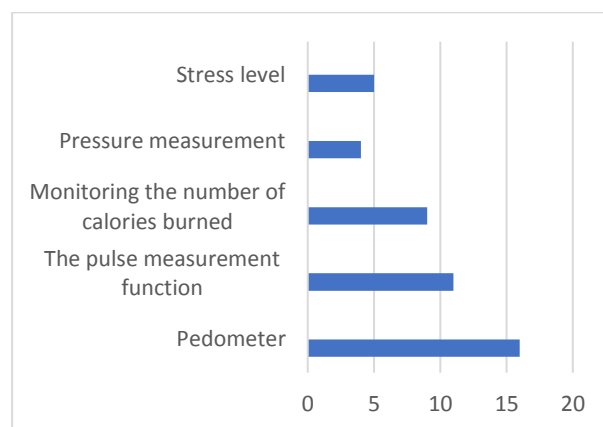


Figure 2 - The most popular features in Smart Health Bracelets

**Analysis of advantages and disadvantages.** Based on the information provided, the following advantages and disadvantages of using smart health bracelets can be identified.

**Advantages:** convenient and easy to operate, versatility, do not require special knowledge to measure the main indicators, help to collect data on health status and correctly distribute physical activity, increase motivation for regular workouts. Suitable for permanent wear. Collect data without an internet connection.

**Disadvantages:** Measurement errors Some models discharge quickly Relatively high cost of some models Require additional devices for charging, the need to connect to a smartphone, not compatible with every software and application.

**Conclusion.** A modern gadget called a health bracelet (or fitness watch) is very popular today. Thanks to their functions, smart bracelets help to monitor the state of health during any physical activity, analyzing the most important vital signs using various sensors and sensors.

Currently, these bracelets cannot replace professional medical devices due to lower measurement accuracy, however, due to the constant development of technology, these gadgets do not stop in their improvement.

I believe that in the future smart health bracelets will become indispensable assistants for every person, thereby making a huge contribution to the development of medicine.

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