HEALTH TECH

HEART RATE MONITOR DEVICE – SMART RINGS

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I. Device[1]

A smart ring is a wearable electronics device loaded with mobile components like sensors and NFC chips that are used for a variety of applications, mostly tracking daily activities and as a peripheral tool to support mobile devices. This makes smart rings a nifty alternative to smart watches and fitness bands. But smart ring applications go beyond monitoring steps or as an extension of your smartphones.

Figure 1. An example image of a smart ring.
Source: https://ouraring.com/product/heritage-silver

Figure 2. An example of a smart ring's structure [1]

Most smart rings don't have only one functionality. For instance, one smart ring can track both your sleeping habits and daily activities. Other smart rings can do both on top of other features like contactless payments and online security.

Depends on different smart rings, there can be a lot of technologies inside a ring, for example an NFC chip, sensor, Bluetooth chip, battery, microcontroller, and light indicator.

II. Usage

Smart ring devices can be used for a range of applications. The most common uses we've seen on the market nowadays are in the health and fitness category. But other practical applications include digital payments, online security, and access control[1].

1. Heath & wellness management

Smart rings are capable of tracking health parameters like heart rate, blood oxygen levels (SpO2), blood pressure, and glucose levels, among others.

Meanwhile, some smart rings can be used to measure a user's stress level through Electrodermal Activity (EDA), the same reference used in lie detector tests to evaluate emotion and cognition through the skin.

2. Sleep monitoring

Figure 3. Sleep tracking ring

Sleep-tracking smart rings keep tabs on sleep patterns, including how much sleep you get, sleep disturbances, and how much time is spent in the different sleep cycles.

3. Fitness tracking

Fitness tracking is a common functionality among smart ring devices. Fitness smart rings can monitor daily activities, including the number of steps taken, distance traveled while walking, and calories burned.

4. Contactless payments

With a contactless payment ring, you can tap-to-pay transactions below the local floor-limit on Visa and MasterCard contactless payment terminals globally.

Figure 4. Smart ring used in contactless payments

5. Online security

Motiv Ring, for instance, uses two-factor authentication (2FA) for web log-ins with the help of its app and preset gesture control.

In development are biometric authentication based on a user's electrocardiogram (ECG) and gait, or the manner a person walks. Like face recognition and fingerprint scanning, ECG is far safer and more resilient against hacking, identity theft, phishing, and other malicious attacks.

6. **Remote control**

Most smart rings have capabilities that allow you to control your smartphone and other devices. Whether it's to set alarms, receive message or call notifications, or control music, smart rings are a great tool to minimize your screen time and increase your productivity.

7. **Smart key**

Some smart rings that have optical sensor inside them that enables you to open your home, car, or office instead of using a traditional physical key, access card, or badges.

Figure 5. Smart ring as a contactless key [1]

8. **Transit pass**

Some NFC smart rings can serve as a travel pass or ticket for public transportation with tap-to-pay card reader terminals at transit gates. These smart rings are essentially stored-value cards (SVC), keeping the monetary value of the travel fund readily available without any third-party support of credit or debit accounts or network connection required.

III. Users

Comparing to smart watches, smart rings also have lots of things in common. But some people would choose a smart ring over a smart watch for different reasons[2]:

1. **Features**: Both smart rings and smart watches have sensors to track user's biometric data.
2. **Accuracy**: Smart rings are generally more accurate than smart watches simply because of their form factor's intrinsic design. Human fingers have many

arteries and capillaries, allowing smart rings to get more accurate data than the wrist.

3. **Comfort**: Smart rings are very lightweight.
4. **Durability**: In terms of the quality of the build, smart rings and smart watches don't differ too much from each other.
5. **Privacy**: Exposing personal information is not a problem with smart rings since they often don't have a display and loud speaker.
6. **Battery**: Smart rings tend to last longer than smart watches.
7. **Pricing**: A decent smart watch with fitness and activity tracking capabilities cost around $150 and up to $600, depending on the brand. Meanwhile, smart rings in the same segment can range between $100 and $300.

For example, a fictional user A is very fond of technology devices. But she doesn't like the idea of replacing her traditional watch to a smart watch and still wants the technologies a smart watch has to offer, she would then buy a smart ring.

IV. Sensors

Several varieties of the sensors used in smart-rings include a heat, heartbeat sensor, an accelerometer, EDA sensors, NTC thermistor[3].

An example of the sensor used in the Oura ring to monitor heart rate is The Infrared Photoplethysmography (PPG) Sensors[4].

The heartbeat monitor is a smart wearable device that detects heartbeat from the body. This smart instrument uses photoplethysmography (PPG) technology and also has two sensors. The first sensor is for detecting light and another for determining motion. Its function is that the light is irradiated by the skin with a LED and then the light reflected from the body hits the detector and changes in heartbeat and body movement are measured. These optical monitors use accelerometers to detect motion[5].

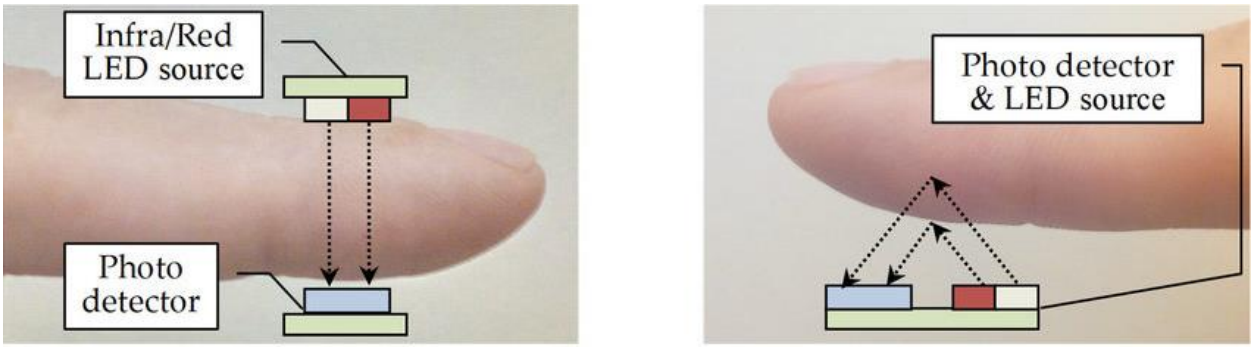

Figure 6. Basic principle of PPG sensors working in: (a) transmission, (b) reflection modes.
Source: www.researchgate.net/figure/Basic-principle-of-PPG-sensors-working-in-a-transmission-b-reflection-modes_fig1_347589318

V. Data collection

The Oura ring can be used as an example of how data is processed on a smart ring. According to Oura, the following personal data categories about the device and application users are processed[6]:

- **Contact information** such as email address or physical address
- **User information** such as gender, height and weight, User ID, and other provided information
- **Device information** such as IP address and location data
- **User-provided activity and contextual information** such as the activities, notes, comments, and tags provided within the app
- **Measured data** such as heart rate, movement data, and temperature data
- **Calculated user, sleep, health, and activity data** such as sleep phases (deep, light, REM, awake), activity levels throughout the day, readiness level, and body mass index (calculated based on height and weight).

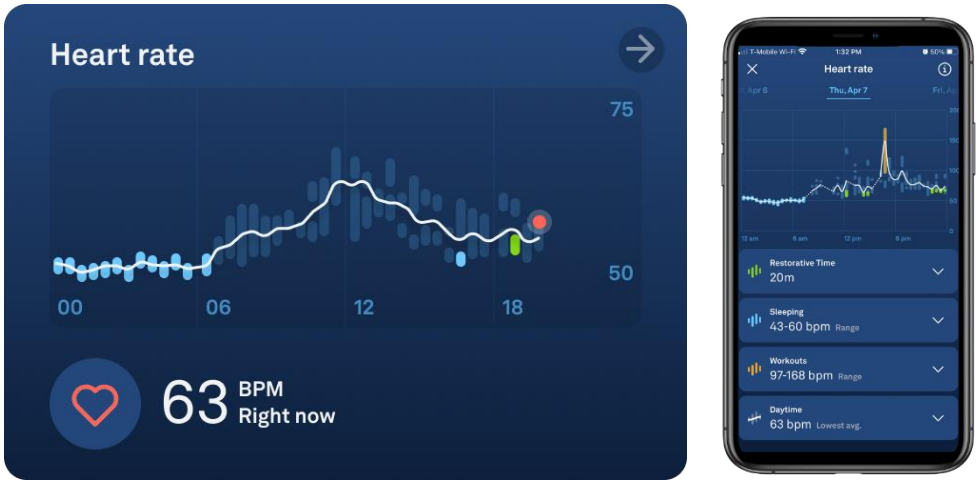

Figure 2. Data recorded by the Oura ring on the Oura app.
Source: https://support.ouraring.com/hc/en-us/articles/4410656562579-Heart-Rate-Graph

The collected data is synced with Oura App via Bluetooth[7]. Those data can also be uploaded to Oura Cloud via the Oura mobile app. The data can be accessed using the Oura mobile app or Oura on the web[8].

References

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