Biowave—a Biometric Watch Activated by Veins

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Located in a watch buckle, the Biowave is an ID-wearable replacing passwords and cards. Identified by their unique wrist vein pattern, the Biowave owner can gain access to devices (computer…), services (banking, medical, transport…), and premises (work, home, car...) securely and reliably. The device is only 5.5 mm thick and has two weeks battery life. A smartwatch version of the Biowave is currently also being commercialized.

The vein pattern on our wrist is a unique biometric signature that can be used for personal identification. CSEM developed a complete hardware solution for the startup Biowatch SA, allowing the integration of a biometric recognition system in a watch buckle for identification. The system consists of a flat vision system with near-infrared active illumination, biometric processing capabilities and two communication schemes, Near-Field Communication (NFC) and Bluetooth Low Energy (BLE). Once identified thanks to his/her unique vein pattern, the owner can authenticate securely and proceed to banking transactions, get access to a computer, a building or a car. No pins, passwords, cards or keys are required anymore.

The user performs his/her identification once a day by taking an image of their wrist with the watch buckle deployed (Figure 1). An active infrared illumination enhances the contrast of the veins on the skin. The embedded biometric algorithm is then performed on the wrist image, delivering the identification if the vein pattern image matches with the one stored in the device. This stored image is acquired in a unique enrolment procedure done at the first use of the device. The watch then is closed, and the user identification is kept as long as it remains closed. A proximity sensor ensures that if the buckle moves away from the skin, the identification is lost, as well as if the mechanical clasp of the buckle is opened.

Once identified, the user can securely connect to a device using a simple gesture to authorize a service like unlocking an access to a car, an office, a computer or a transport network, or authorizing a sensitive transaction like a bank transfer. This authentication to services, devices and premises is performed contactless either by NFC or BLE.

The challenges for such a wearable were multiple: it must be highly secured, reliable, low power, and extremely slim.

- The security of the device relies on several aspects: a False Acceptance Rate (FAR) lower than 0.001%, an embedded processing, an NFC chip including a secure element allowing secured data storage and data encryption, a mechanical clasp and a proximity sensor.
- The reliability of the device is shown by a False Rejection Rate (FRR) lower than 1%.
- The autonomy of the device is due to hardware and firmware optimizations. The BLE supervises the incoming events (accelerometer, button or NFC/BLE signals) while keeping unused components in deep sleep modes, to achieve a lifetime of two weeks before a device recharge.
- The ergonomy of the device was reached by a drastic reduction of the thickness thanks to a complete redesign of the optical system (selection of the most convenient imager and design of a wafer scale custom optics). The complete optical system achieves 1.8 mm thickness (imager + optics).

Figure 1: Biowatch buckle (left) and identification process (right).

The Biowave system was designed through a meticulous choice for the target components, allowing the implementation of all the use cases of the Biowatch business (banking, access control, online authentication, etc.) to bring maximum benefit to its customers. The system has been implemented on an 8-layers printed circuit board with chip-scale packages for all components (imager, microcontroller, flash memory, BLE, NFC, secure element, accelerometer, colour LEDs for feedback). Custom antennas have been designed for BLE and NFC communications. The flat optics has been prototyped thanks to CSEM replication technology expertise, providing high quality veins images (Figure 2). A custom battery supplies 44 mAh capacity enabling two weeks autonomy. The final module reaches the expected volume of 30×17×5.5 mm.

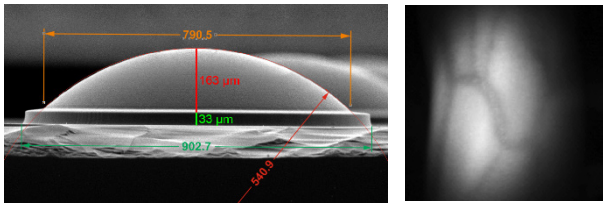

Figure 2: Wafer scale custom lens (left) and veins imaging (right).

The Biowave system has been implemented in a smartwatch form factor first, allowing Biowatch to quickly deliver its early customers with fully functional prototypes – from the biometric recognition to the personal authentication activation (Figure 3). Further improvements are underway to increase the level of security, by integrating a heart rate detection (liveness) and the resilience to presentation attacks (spoofing tentative).

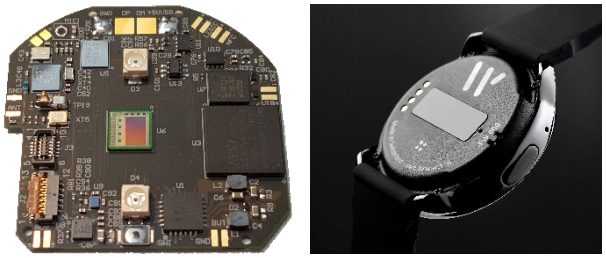

Figure 3: The Biowave smartwatch board (left) and prototype (right).