



Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle Since 1965



Responder Technology Alert Monthly (Oct-Nov 2014)

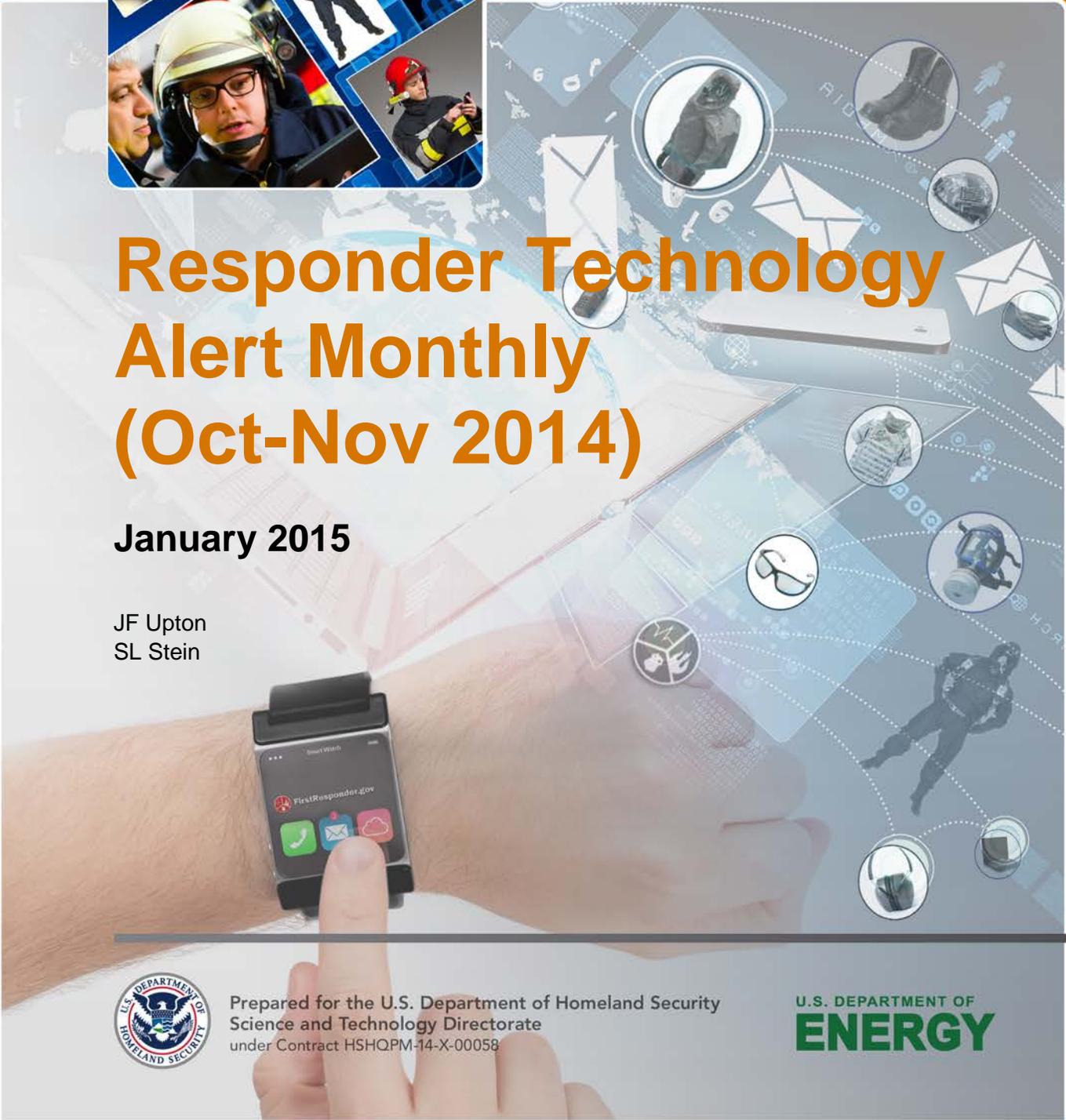
January 2015

JF Upton
SL Stein



Prepared for the U.S. Department of Homeland Security
Science and Technology Directorate
under Contract HSHQPM-14-X-00058

U.S. DEPARTMENT OF
ENERGY



DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor Battelle Memorial Institute, nor any of their employees, makes **any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights.** Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or Battelle Memorial Institute. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service
5301 Shawnee Rd., Alexandria, VA 22312
ph: (800) 553-NTIS (6847)
email: orders@ntis.gov <<http://www.ntis.gov/about/form.aspx>>
Online ordering: <http://www.ntis.gov>



This document was printed on recycled paper.

(8/2010)

Responder Technology Alert Monthly (Oct-Nov 2014)

JF Upton
SL Stein

January 2015

Prepared for the Department
of Homeland Security Science and
Technology Directorate under Contract
HSHQPM-14-X-00058.

Pacific Northwest National Laboratory
Richland, Washington 99352

Acronyms and Abbreviations

ACC	accelerometer
AR	augmented reality
CC	carbon cotton
DARPA	Defense Advanced Research Projects Agency
DCRS	Dipole Coil Resonant System
DHS	Department of Homeland Security
FCB	fabric circuit board
GPS	global positioning system
HRV	heart rate and rate variability
IoT	Internet of things
MA	motion artefact
NPL	National Physical Laboratory
PNNL	Pacific Northwest National Laboratory
RTA	Responder Technology Alliance
WHMS	Wearable healthcare monitoring systems

Contents

Acronyms and Abbreviations	iii
1.0 Introduction	1.1
2.0 Sensors.....	2.2
2.1 Physiological	2.2
2.1.1 3L Labs: Footlogger	2.2
2.1.2 Adidas: MiCoach.....	2.2
2.1.3 Athos: Core	2.2
2.1.4 BabyBe	2.3
2.1.5 BabyGuard	2.3
2.1.6 Backtrack.....	2.3
2.1.7 Bar-Ilan University.....	2.4
2.1.8 Bebop Sensors, Inc.: Wearable Smart Fabric Sensor	2.4
2.1.9 BioSensive Technologies: Ear-o-Smart	2.4
2.1.10 BITalino	2.5
2.1.11 BSXinsight	2.5
2.1.12 Catapult Sports	2.5
2.1.13 CharmCare: H2	2.6
2.1.14 Chinese PLA, General Hospital	2.6
2.1.15 Code4Armour.....	2.6
2.1.16 Electrozyme.....	2.7
2.1.17 embr Labs: Wristify	2.7
2.1.18 Empatica: Ebrace.....	2.7
2.1.19 Evoke Neuroscience.....	2.8
2.1.20 FitLinxx: AmpStrip.....	2.8
2.1.21 Force Impact Technologies: FITGuard	2.9
2.1.22 FuelWear: Flame Base Layer	2.9
2.1.23 HealthWatch: hWear™	2.9
2.1.24 Hexoskin: Smart Tee.....	2.10
2.1.25 Imperial College of London: AcuPebble.....	2.10
2.1.26 Institute of Biomedical Engineering.....	2.10
2.1.27 Intel and Anouk Wripprecht: Synapse	2.11
2.1.28 Khalifa University of Science, Technology, & Research.....	2.11
2.1.29 LifeBeam.....	2.11
2.1.30 MC10: Biostamp	2.12
2.1.31 Medtronic: Seeq	2.12
2.1.32 Moodmetric	2.12

2.1.33	Myontec: Mbody Coach.....	2.13
2.1.34	Netatmo	2.13
2.1.35	NewDealDesign: Project Underskin	2.13
2.1.36	Northwestern University and University of Illinois at Urbana-Champaign.....	2.14
2.1.37	Olive.....	2.14
2.1.38	Qardio, Inc.: QardioCore.....	2.15
2.1.39	Rijuven: Rejiva®.....	2.15
2.1.40	Sensogram: SensoTRACK.....	2.15
2.1.41	Sensoria.....	2.15
2.1.42	Smartcadia: InnerYou (INYU).....	2.16
2.1.43	Spire	2.16
2.1.44	Spree: Smartcap.....	2.16
2.1.45	Thync: Vibes	2.17
2.1.46	University of Buffalo, Sentient Science	2.17
2.1.47	University of Cincinnati.....	2.18
2.1.48	University of Memphis.....	2.18
2.1.49	V1bes.....	2.19
2.1.50	Valencell: PerformTek	2.19
2.1.51	Welch Allyn and Gentag	2.19
2.1.52	Zoll: Life Vest	2.20
2.2	Chemical/Particle	2.20
2.2.1	Borre Akkersdijk and Martijin ten Bhomer (individuals): BB.Suit 2.0	2.20
2.2.2	Chemisense.....	2.20
2.2.3	Frog Shanghai: AirWaves	2.21
2.2.4	HabitatMaps: AirBeam	2.21
2.2.5	Morphix Technologies: Chameleon.....	2.21
2.2.6	Nanozen.....	2.22
2.2.7	NTT Docomo: Docotch.....	2.22
2.2.8	TZOA: Enviro Tracker.....	2.22
2.2.9	UC Berkeley: Clarity.....	2.23
2.2.10	WindSix.....	2.23
2.3	Other.....	2.24
2.3.1	Bionym: Nymi.....	2.24
2.3.2	Captiks: Movit.....	2.24
2.3.3	Sail Research: Pathfinder	2.24
2.3.4	Samsung: Simband.....	2.25
3.0	Displays	3.2
3.1	Heads-Up.....	3.2
3.1.1	Ashkelon Enterprises.....	3.2

3.1.2	Atheer Labs	3.2
3.1.3	DAQRI	3.2
3.1.4	Elbit Systems: Skylens™	3.3
3.1.5	Fusar Technologies: Guardian.....	3.3
3.1.6	Google	3.3
3.1.7	I2i: iPal	3.4
3.1.8	Magic Leap: Dynamic Digitized Lightfield Signal™	3.4
3.1.9	Mitsumi	3.5
3.1.10	NUVIZ	3.5
3.1.11	Optinvent: Ora.....	3.5
3.1.12	Recon Instruments: Snow2.....	3.6
3.1.13	SAP and Vuzix	3.6
3.1.14	Skully	3.6
3.1.15	Sony: SmartEyeglass.....	3.7
3.1.16	TrackingPoint: ShotGlass™.....	3.7
3.1.17	University of Fukui	3.7
3.2	Body-worn.....	3.8
3.2.1	Arubixs: Portal	3.8
3.2.2	Cricet.....	3.8
3.2.3	Kyocera: Proteus	3.9
3.2.4	Proglove	3.9
4.0	Power.....	4.2
4.1	Chargers/Batteries	4.2
4.1.1	BAE Systems: Broadsword.....	4.2
4.1.2	Korea Advanced Institute of Science and Technology: Dipole Coil Resonant System	4.2
4.1.3	Nifty: XOO.....	4.2
4.1.4	Panasonic.....	4.3
4.1.5	Samsung	4.3
4.1.6	UBeam.....	4.3
4.2	Self-powering/Harvesting	4.4
4.2.1	A*STAR Institute of Microelectronics (IME)	4.4
4.2.2	AMPY	4.4
4.2.3	Columbia Engineering and the Georgia Institute of Technology.....	4.4
4.2.4	Fudan Univeristy, China	4.5
4.2.5	Georgia Institute of Technology.....	4.5
4.2.6	Korea Advanced Institute of Science and Technology	4.5
4.2.7	Pauline Van Dongen: Wearable Solar.....	4.6
4.2.8	Rajesh Adhikari (Individual).....	4.6

4.2.9	Sungkyunkwan University: Perovskite Solar Cells.....	4.7
4.2.10	Tommy Hilfiger.....	4.7
4.2.11	U.S. Marine Corps Expeditionary Energy Office (E2O): Marine Austere Patrolling System	4.7
4.3	Power Supply	4.8
4.3.1	Acticheck Assure.....	4.8
4.3.2	Drexel University, Dalian University of Technology: Mxenes.....	4.8
4.3.3	Massachusetts Institute of Technology (MIT)	4.9
4.3.4	Mixel	4.9
4.3.5	Samsung	4.9
4.3.6	Taiwan Semiconductor Manufacturing Company Limited.....	4.10
4.3.7	TE Wearables Lab.....	4.10
5.0	Integrated Communications.....	5.2
5.1	Bluetooth.....	5.2
5.1.1	OnBeep: Onyx.....	5.2
5.1.2	Yak Hat	5.2
5.2	Hands-free operation	5.3
5.2.1	16Lab: OZON™.....	5.3
5.2.2	Easier to Use LLC: GoGlove	5.3
5.2.3	Elliptic Labs	5.4
5.2.4	Murata	5.4
5.2.5	Mycestro.....	5.4
6.0	Exoskeletons.....	6.2
6.1.1	Defense Advanced Research Projects Agency (DARPA): Airlegs.....	6.2
6.1.2	Ekso.....	6.2
6.1.3	Harvard Wyss Institute for Biologically Inspired Engineering: Soft Exosuit	6.2
6.1.4	Purdue University.....	6.3
6.1.5	StretchSense: I Measure U	6.3
6.1.6	Tokyo University of Science and Innophys Co.: Muscle Suit	6.3
7.0	Wearable Computers	7.2
7.1.1	Raytheon.....	7.2
7.1.2	Tufts University.....	7.2
7.1.3	University of Canterbury.....	7.2
8.0	General	8.2
8.1.1	Actuate: BIRT iHub and Analytics	8.2
8.1.2	Allied Minds: Seamless Devices, Inc.....	8.2
8.1.3	Alpinestar: Tech-Air	8.2
8.1.4	Arco: Smart Reactor.....	8.3
8.1.5	ARM Holdings: MBED OS	8.3

8.1.6 Betatrac: eBodyGuard	8.3
8.1.7 Body Biolytics.....	8.4
8.1.8 Clone: Algo	8.4
8.1.9 DOCTO	8.4
8.1.10 Ducere Technologies: Lechal.....	8.5
8.1.11 Eidos.....	8.5
8.1.12 FacialNetwork Inc.: Orbit	8.6
8.1.13 Google	8.6
8.1.14 Imagination.....	8.6
8.1.15 Ineda Systems.....	8.6
8.1.16 Institute of Textiles and Clothing	8.7
8.1.17 Invensense®: MotionTracking™	8.7
8.1.18 iStrategyLabs: Dorothy	8.8
8.1.19 Karen Janssen: HERE for Gear	8.8
8.1.20 Korean Agency for Technology	8.8
8.1.21 Lineable.....	8.9
8.1.22 MEU	8.9
8.1.23 Microsoft	8.9
8.1.24 Myo-systems: PurePhones	8.10
8.1.25 Nanyang Technological University.....	8.10
8.1.26 National Physical Laboratory	8.10
8.1.27 Ohio State University	8.11
8.1.28 OriginGPS: NanoSpider.....	8.11
8.1.29 Ramco	8.11
8.1.30 Re-Timer	8.12
8.1.31 Soundhawk.....	8.12
8.1.32 Tech Museum of Innovation: Body Metrics Exhibit.....	8.12
8.1.33 Toshiba: AppLite™.....	8.13
8.1.34 Tsinghua University: iGaze.....	8.13
8.1.35 University of Adelaide	8.13
8.1.36 University of California: Hush	8.14
8.1.37 University of Texas	8.14
8.1.38 University of Tokyo	8.14
8.1.39 Viametrica and SensorUp.....	8.15
8.1.40 Visual Intelligence: iOne.....	8.15
8.1.41 Wearable Experiments: Navigate	8.15
8.1.42 Zikto: Arki.....	8.16
Appendix A Technology Summary	A.1

1.0 Introduction

The Pacific Northwest National Laboratory (PNNL) is supporting the Department of Homeland Security (DHS) to advance technologies to enhance responder health and address complex and changing threat environments. The DHS Science and Technologies First Responders Group established the Responder Technology Alliance (RTA) to accelerate the development of solutions to first responder needs and requirements by identifying, analyzing, and recommending solutions that improve responder safety, enhance their ability to save lives, and minimize property loss. The end goal is for RTA to develop and implement strategies that will make effective solutions available to first responders.

As part of technology foraging for the RTA, this report summarizes technologies that are relevant in the area of “wearables,” with the potential for use by first responders. The content was collected over the previous month(s) and reproduced from a general Internet search using the term wearables. Additional information is available at the websites provided. The content is organized by technology function including:

- Sensors – Devices that detect physiological, particle, and chemical activity
- Displays – Heads-up and body-worn visual displays
- Power – Wearable power systems including chargers, batteries, self-powering or harvesting technologies, and power supplies
- Integrated Communications – Voice and data communications systems utilizing Bluetooth, wireless, hands-free, ergonomically optimized systems, noise-filtering digital speakers or microphones, etc.
- Exoskeletons – Whole or partial body suit that enhances mobility and physical performance
- Wearable Computers – Body-worn data processing devices
- General – Miscellaneous technologies as well as emerging trends or recent advances in the field of wearables.

This report is not meant to be an exhaustive list nor an endorsement of any technology described herein. Rather, it is meant to provide useful information about current developments in the areas wearable technology.

A spreadsheet summarizing these technologies is available in Appendix A. For an electronic copy, contact Jaki Upton at jaki.upton@pnnl.gov.

2.0 Sensors

2.1 Physiological

2.1.1 3L Labs: Footlogger

Website: <http://www.footlogger.com/>

Technology name: Footlogger

Description: FootLogger is a Bluetooth-connected shoe insole activity tracker delivering wearable technology inside the shoe. The device is anticipated to have applications in healthcare, sports, and recreation.

Status: Soon to be released

Funding Source/Mechanism:



Photo source: <http://www.footlogger.com>

2.1.2 Adidas: MiCoach

Website: <http://micoach.adidas.com/>

Technology name: MiCoach

Description: The MiCoach product line includes a heart rate monitoring shirt that pairs with an app that reports data as the wearer exercises. The "smart fabric" technology incorporates special sensing fiber electrodes knit directly into the garment.

Status: Available

Funding Source/Mechanism:

2.1.3 Athos: Core

Website: <http://www.liveathos.com/>

Technology name: Core exercise shirts and shorts with built in sensors

Description: The Core sensor contains the electronics and intelligence to collect and interpret biosignals, sending the information to a mobile device via Bluetooth. Measures muscle effort, muscle fatigue, heart rate, heart rate variability, recovery rates, and breathing patterns.

Status: Soon to be released

Funding Source/Mechanism:



Photo source:
<http://www.liveathos.com/apparel/technology>

2.1.4 BabyBe

Website: <http://iq.intel.com/new-wearable-deepens-connection-mothers-premature-babies/>

Technology Name: BabyBe

Description: BabyBe is a bionic mattress that brings haptic information from the mother to the baby. The sensor system pulls real-time information from a mother's chest – breathing and heartbeat – and sends it wirelessly to the baby. The information can be recorded and retransmitted to the baby through a pneumatic pump embedded in the baby's mattress, even when the parent is not there.



Photo source:
<https://www.indiegogo.com/projects/babybe-be-with-your-baby>

Status: Evolving

Funding Source/Mechanism:

2.1.5 BabyGuard

Website: <http://thecreatorsproject.vice.com/blog/now-you-can-monitor-your-infants-vitals-with-wearable-technology>

Technology name: BabyGuard

Description: BabyGuard gives parents real-time data on their infants through sensor units embedded in clothing. Using a core sensor to measure electrophysiological signals, and Intel Edison technology, BabyGuard puts vital data monitoring into parents' hands. Team BabyGuard will use Intel Edison technology in their prototype to transmit and process data such as EEG, FECG and EMG signals.

Status: Evolving

Funding Source/Mechanism: \$50,000 from Make it Wearable campaign.

2.1.6 Backtrack

Website: <https://www.kickstarter.com/projects/1606164085/backtrack-quantify-recovery?ref=kicktraq>

Technology Name: Backtrack

Description: The device is worn alongside of your spine; it bends as you bend. The sensors track data points like pressure, angle of movement, etc. Technically, it uses inertial measurement unit sensors combined together to sense relative position and shape. The data is then sent to your phone over Bluetooth.

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.7 Bar-Ilan University

Website: <http://www.wearablestechcon.com/news/lasers-and-magnets-measure-glucose-levels-in-armband-wearable>

Technology Name: Glucose tester wristband

Description: This wearable biometric system utilizes lasers and a magnet to directly monitor glucose levels in the blood stream. Researchers developed a method of measuring glucose density with a wrist-worn device. The armband can analyze the “the speckle effect” produced as the glucose molecules pass by the magnet. The speckle refers to resulting noise on the image taken by the laser. The more noise, the higher the glucose density will be. The device will also determine relative dehydration of subjects, utilizing the laser to measure muscle weakness.

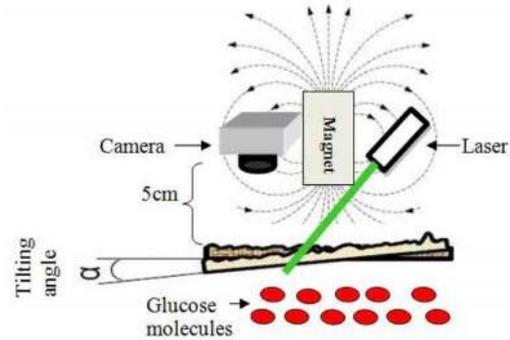


Photo source: <http://www.wearablestechcon.com/news/lasers-and-magnets-measure-glucose-levels-in-armband-wearable>

Status: Evolving

Funding Source/Mechanism:

2.1.8 BeBop Sensors, Inc.: Wearable Smart Fabric Sensor

Website: <http://www.bebopsensors.com/>

Technology name: Wearable Smart Fabric Sensor

Description: BeBop’s Monolithic Fabric Sensors integrate sensors, traces, and electronics into a single piece of fabric to provide greater sensitivity, resolution, range of deployment, and robustness -- all with a tiny size and able to integrate into new wearable products.

Status: Available

Funding Source/Mechanism:

2.1.9 BioSensive Technologies: Ear-o-Smart

Website: <http://www.itproportal.com/2014/11/13/fitness-tracking-earring-looking-shake-wearable-tech-market/>

Technology Name: Ear-o-Smart

Description: The earring uses Bluetooth 4.0 wireless technology to connect to a smartphone and monitors the user’s heart rate, activity level, and calorie burn. The Ear-o-Smart uses photoplethymogram technology to measure blood flow through the skin. The ear-lobe sensors provide better contact with the skin than wrist-based monitors.



Photo source: <http://www.itproportal.com/2014/11/13/fitness-tracking-earring-looking-shake-wearable-tech-market/>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.10 BITalino

Website: <http://www.bitalino.com/>

Technology Name: BITalino

Description: BITalino is a low-cost, purpose-built, all-in-one hardware and software toolkit designed for quick and easy creation of projects with body signals, development of quantified self-wearable devices or apps, and/or learning how to build medical devices. BITalino provides versatile, Arduino-compatible

software and hardware blocks with sensors for Electrocardiography (ECG), Electromyography (EMG), Electrodermal Activity (EDA), Accelerometry (ACC), and Ambient Light (LUX), including Bluetooth low-energy wireless communication to a software toolkit to see the signals in real time or replay offline.



Photo source: <http://www.bitalino.com/index.php/board-kit>

Status: Original version: available

Funding Source/Mechanism: Crowdfunding to reduce cost

2.1.11 BSXinsight

Website: <http://www.bicycle.net/2014/product-review-bsxinsight-wearable-lactate-threshold-sensor>

Technology Name: Wearable Lactate Threshold Sensor

Description: BSXinsight is a small wearable device able to analyze changes in an exercising muscle to immediately identify lactate threshold. It attaches around the user's calf in a compression sleeve that comfortably slides on. The BSXinsight test was 99.9% accurate to the blood prick test that was done at the same time.



Photo source: http://www.bicycle.net/wp-content/uploads/2014/10/device_sleeve.jpg

Status: Available

Funding Source/Mechanism: Crowdfunding

2.1.12 Catapult Sports

Website: <http://www.catapultsports.com/united-states/>

Technology name: Sporting wearables

Description: Catapult Sports' sporting wearables fit under players' sports gears, measure more than 100 points of data (i.e., heart rate, distance, velocity, acceleration and deceleration, speed, and shock), and link players to their coaches with technical and analytical performance data on athlete risk, readiness, and return to play.

Status: Some are available and some are soon to be released.

Funding Source/Mechanism:

2.1.13 CharmCare: H2

Website: <https://www.indiegogo.com/projects/h2-the-first-wearable-blood-pressure-monitor>

Technology Name: H2 Wearable Blood Pressure Monitor

Description: The H2, proclaimed the world's "smallest and lightest wearable blood pressure monitor," tracks blood pressure in just 20 seconds and, compared to similar devices, does not require a smart phone or computer in order to operate.



Photo source:
<https://www.indiegogo.com/projects/h2-the-first-wearable-blood-pressure-monitor>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.14 Chinese PLA, General Hospital

Website: <http://www.ncbi.nlm.nih.gov/pubmed/25273839>

Technology name: Wearable healthcare monitoring systems (WHMS) with GALL and Kalman filters

Description: Researchers are investigating the use of an adaptive filter to reduce motion artefact (MA) in physiological signals acquired by WHMSs. A WHMS is used to acquire ECG, respiration and triaxial accelerometer (ACC) signals during incremental treadmill and cycle ergometry exercises. The results show that for the respiratory signals, MA component can be reduced and signal quality can be improved effectively. Combination of the GALL and Kalman filters can achieve robust MA cancellation without supervised selection of the reference axis from the ACC. For ECG, the MA component can also be reduced by adaptive filtering. The signal quality, however, could not be improved substantially just by the adaptive filter with the ACC outputs as the reference signals.

Status: Evolving

Funding Source/Mechanism:

2.1.15 Code4Armour

Website: <https://www.code4armour.com/>

Technology name: Alert wristband

Description: Code4Armour is a shock-resistant, water-resistant, battery-free wearable device and mobile app that gives First Responders instant access to critical personal health information via a patent-pending VitalSpeak™ text-to-speech engine.



Photo source: <https://www.code4armour.com/>

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding

2.1.16 Electrozyme

Website: <http://www.psfk.com/2014/11/electrozyme-wearable-fitness-sweat-sensor.html>

Technology Name: Electrozyme

Description: Electrozyme is a biosensor strip that analyzes the chemical composition of the wearer's sweat and delivers real-time feedback and tailored advice to avoid injury and optimize performance.



Photo source: <http://www.psfk.com/2014/11/electrozyme-wearable-fitness-sweat-sensor.html>

Status: Soon to be released

Funding Source/Mechanism:

2.1.17 embr Labs: Wristify

Website: <http://www.embrlabs.com/>

Technology name: Wristify

Description: This thermoelectric bracelet regulates the user's temperature by subjecting their skin to alternating pulses of hot or cold and is capable of changing that surface at a rate of 0.4 degrees Celsius per second.



Photo source: <http://www.embrlabs.com/>

Status: Evolving

Funding Source/Mechanism: The prototype recently won first place at this year's MADMEC, an annual competition put on by the MIT's Materials Science and Engineering program, netting the group a \$10,000 prize, which will be used to continue development.

2.1.18 Empatica: Ebrace

Website: <http://www.prnewswire.com/news-releases/empatica-launches-indiegogo-crowdfunding-campaign-to-make-medical-quality-wearable-device-affordable-and-accessible-to-consumers-283175931.html>

<http://www.gizmodo.com.au/2014/11/how-a-medical-stress-sensor-evolved-into-a-beautiful-wearable-for-all/>

<http://www.technologyreview.com/news/532811/a-sleek-wristband-that-can-track-seizures/>

Technology Name: Embrace wristbands

Description: These medical-quality wearables help measure stress, epileptic seizures, activity and sleep. The wristbands' medical-grade internals include a sensor that measures electrodermal activity, which can help monitor stress and predict seizures. Embrace detects moisture — or sweat — on the skin to measure small changes in the “fight-or-flight response.”

Status: Evolving

Funding Source/Mechanism: Crowdfunding and private donors

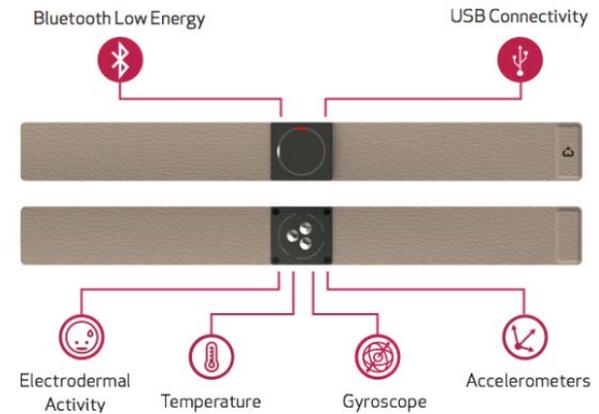


Photo source: <http://www.gizmodo.com.au/2014/11/how-a-medical-stress-sensor-evolved-into-a-beautiful-wearable-for-all/>

2.1.19 Evoke Neuroscience

Website: <http://www.evokeneuroscience.com/index.html>

Technology name: Brain activity and heart rate variability (HRV) sensors

Description: The sensors gather data via high-end headphones and an arm band and pair with the Evoke app via Bluetooth to provide information about the user's biometric activity.

Status: Soon to be available

Funding Source/Mechanism:

2.1.20 FitLinxx: AmpStrip

Website: <http://www.wearabletechworld.com/topics/wearable-tech/articles/394220-fitlinxx-announces-ampstrip-wearable-heart-activity-monitor.htm>

Technology Name: AmpStrip wearable heart and activity monitor

Description: The AmpStrip is a discrete sensor-filled device that attaches to a user's torso and continuously tracks data such as heart rate, activity, respiration, body temperature and posture. The device tracks the user's sleep-recovery cycle by monitoring data during rest, recovery and sleep in addition to workouts. The device is waterproof, comfortable, and hypoallergenic, with medical-grade adhesive rated to maintain attachment for 3-7 days and battery life of approximately 7 days of constant wear.

Status: Soon to be released

Funding Source/Mechanism:

2.1.21 Force Impact Technologies: FITGuard

Website: <http://inbusinessmag.com/technology-innovation/wearable-tech-small-big-data#.VIofQE0cSM8>

Technology Name: FITGuard mouthpiece

Description: FITGuard, the “brain’s check-engine light,” combines an accelerometer that measures how fast something starts and stops and a gyroscope that measures how fast it spins. The sensors can monitor the center of gravity of the brain and detect potential head injuries. The information is stored on the device and transferred via Bluetooth to a smartphone. LEDs visually display the force from the impact.



Photo source: <http://inbusinessmag.com/wp-content/uploads/2014/10/FITGuard.jpg>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.22 FuelWear: Flame Base Layer

Website: <http://www.fuelyouradventure.com/>

Technology name: Flame Base Layer

Description: This wearable device warms itself to keep the wearer’s body temperature at the desired temperature. The clothing can be worn for 3-12 hours, depending on the amount of heat it must generate. An embedded sensor in the wearable technology registers the body’s heat in order to continually adjust.

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding

2.1.23 HealthWatch: hWear™

Website: <http://www.prweb.com/releases/2014/11/prweb12303888.htm>

Technology Name: hWear™ smart textile garment

Description: HealthWatch's hWear™ is a digital, heart-sensing garment with interwoven textile electrodes for detecting ECG signals at rest and in motion, without use of electrodes, gels, or shaving preparations. The garments are machine washable and integrate directly with most existing cardiac telemetry systems, with signal quality shown to be comparable to traditional methods.



Photo source: <http://www.personal-healthwatch.com/>

Status: Evolving

Funding Source/Mechanism:

2.1.24 Hexoskin: Smart Tee

Website: <http://www.hexoskin.com/>

Technology name: Biometric Smart Tee

Description: The shirt is equipped with sensors capable of tracking over 3,000 data points every minute. The technology monitors heart rate, breathing rate, activity, and sleep.

Status: Available in US

Funding Source/Mechanism:



Photo source:
<http://www.hexoskin.com/>

2.1.25 Imperial College of London: AcuPebble

Website: <http://www.acupebble.com/>

Technology name: AcuPebble

Description: AcuPebble is approximately the size of a coin and sticks onto a person's neck or chest to wirelessly detect sounds emanating from the heart and respiratory system. AcuPebble monitors multiple breathing and cardiac parameters to determine those that may indicate deteriorating health or illness in patients, which could provide beneficial use to the diagnosis of respiratory and cardiac conditions, including sleep apnea, whooping cough, pneumonia, chronic obstructive pulmonary disease, and congestive heart failure.

Status: Evolving

Funding Source/Mechanism: AcuPebble is a finalist in the \$US 2.25 million Nokia Sensing XCHALLENGE. Teams are competing for a \$525,000 Grand Prize and up to five Distinguished Awards, each valued at \$120,000. The lab leading the research receives funding from the European Research Council under the European Community's 7th Framework Program.



Photo source: <http://www.acupebble.com/>

2.1.26 Institute of Biomedical Engineering

Website: <http://www.ibme.ox.ac.uk/research/biomedical-signal-processing-instrumentation/prof-m-de-vos/truly-wearable-brain-monitoring>

Technology name: Wearable brain monitoring - mobile electroencephalogram (EEG)

Description: This prototype of a near-invisible high-quality brain monitoring device was developed in collaboration with CRITIAS (ETS, Montreal) and Sonomax. The around-the-ear device allows for continuous and reliable monitoring of brain activity and has the additional possibility to record vital signs in a convenient way.



Photo source:
<http://www.ibme.ox.ac.uk/research/biomedical-signal-processing-instrumentation/prof-m-de-vos/truly-wearable-brain-monitoring>

Status: Evolving

Funding Source/Mechanism:

2.1.27 Intel and Anouk Wipprecht: Synapse

Website: <http://venturebeat.com/2014/09/11/the-intel-smart-dress-are-you-bold-enough-to-wear-it/>

Technology name: Synapse dress

Description: Anouk Wipprecht created the “Synapse” smart dress based on biosensors that communicate changes in mood and enable better understanding of fluctuations in attention and stress levels. The dress is powered by Intel’s newly launched “Intel Edison” microcontroller and designed in collaboration with Niccolo Casas. The dress was 3D printed by i.materialise’s parent company Materialise, in the fully-flexible TPU 92A-1. Sensors in the headpiece track the wearer’s attention level and fluctuations; sensors embedded in the dress monitors proximity; and a camera on the front captures a picture whenever the wearer feels either most tense or most relaxed.



Photo source:
<http://www.materialise.com/cases/wearable-tech-just-got-smarter-anouk-wipprechts-intel-edison-powered-3d-printed-synapse-dress>

Status: Evolving

Funding Source/Mechanism: Intel

2.1.28 Khalifa University of Science, Technology, & Research

Website: <http://dx.doi.org/10.1039/C4TA05810K>

Technology Name: Wearable Pressure Sensor made of carbon cottons (CC) with moderate electrical conductive

Description: In this wearable pressure sensor, CCs with moderate electrical conductive were combined with flexible and electrical conductive CC/polydimethylsiloxane composites, allowing for a simple yet highly sensitive pressure sensor. By integrating the pressure sensor with a sport shoe and waist belt, researchers demonstrated that the real-time monitoring of sport performance and health condition.

Status: Evolving

Funding Source/Mechanism:

2.1.29 LifeBeam

Website: <https://gigaom.com/2014/11/04/is-this-hat-the-future-of-the-wearables-market-i-hope-so/>

Technology Name: LifeBeam hat and helmet

Description: This Bluetooth®- and ANT+™-equipped hat uses electro-optical sensors to monitor heart rate, cadence, and calories.

Status: Available

Funding Source/Mechanism: Venture funding - Raised \$2.6 million in a seed round two years



Photo Source: <http://www.life-beam.com/>

2.1.30 MC10: Biostamp

Website: <http://www.mc10inc.com/>

Technology name: Biostamp flexiblesensor

Description: Biostamp adheres to the skin similar to a BAND-AID® or temporary tattoo with sensors that monitor temperature, movement, heart rate and more, and transmit this data wirelessly back to patients and their clinicians. The device has the potential to be used to track various conditions like heart failure, Parkinson's, and seizures as well as infant health.

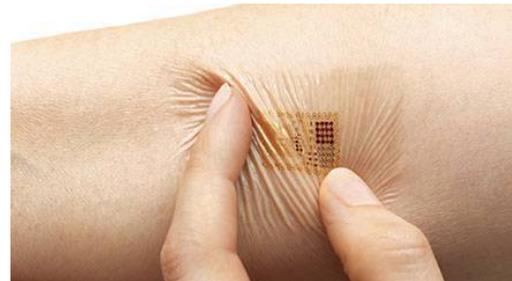


Photo source: <http://www.mc10inc.com/company-information/technology/>

Status: Evolving

Funding Source/Mechanism:

2.1.31 Medtronic: Seeq

Website: <http://www.medtronicdiagnostics.com/us/cardiac-monitors/seeq-mct-system/index.htm>

Technology name: Seeq Mobile Cardiac Telemetry

Description: The Seeq is an adhesive, water-resistant, wireless wearable cardiac sensor that can be worn up to 30 days for continuous cardiac monitoring. The system records and stores every heartbeat and can transmit cardiac event data via Bluetooth and cellular connections to the Medtronic Monitoring Center.



Photo source:
<http://www.medtronicdiagnostics.com/us/cardiac-monitors/seeq-mct-system/index.htm>

Status: Available

Funding Source/Mechanism:

2.1.32 Moodmetric

Website: <http://www.ibtimes.co.uk/moodmetric-smart-ring-unveiled-worlds-smallest-bio-sensor-wearable-1475809>

Technology Name: Moodmetric Smart Ring - a small, wearable biometric sensor

Description: The Moodmetric ring uses bio-sensor technology to measure the "emotional voltage" of the wearer. Skin conductance sensors provide feedback through a Bluetooth connection to a smartphone app, which displays a "mood flower" that maps the various emotional states experienced throughout the day.

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.33 Myontec: Mbody Coach

Website: <http://www.myontec.com/products/>

Technology name: Mbody Coach

Description: Myontec's "intelligent shorts" tell the wearer how hard they are working out, provide personal audio coaching designed to boost performance, and help avoid injury. The shorts use conductive textile sensors to collect the signals through the skin above muscles, called electromyography (EMG).



Photo source:
<http://www.myontec.com/products/>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.34 Netatmo

Website: <https://www.netatmo.com/en-US/product/june>

Technology name: Wrist device

Description: The wrist device records UV exposure and alerts the user if exposure is too great. The device tracks UV intensity in real-time and an app calculates the suggested maximum daily exposure.

Status: Available

Funding Source/Mechanism:

2.1.35 NewDealDesign: Project Underskin

Website: <http://www.fastcodesign.com/3036175/from-the-designers-of-fitbit-a-digital-tattoo-implanted-under-your-skin#3>

Technology name: Project Underskin

Description: The sub-dermal "digital tattoo" will interact and exchange information with a range of devices (doors, credit card readers, etc.).



Photo source:
<http://www.fastcodesign.com/3036175/from-the-designers-of-fitbit-a-digital-tattoo-implanted-under-your-skin#3>

Status: Evolving

Funding Source/Mechanism:

2.1.36 Northwestern University and University of Illinois at Urbana-Champaign

Website: <http://www.northwestern.edu/newscenter/stories/2014/09/skin-like-device-monitors-cardiovascular-and-skin-health.html>

Technology name: Wearable skin monitor

Description: The small device, approximately 5 centimeters square, can be placed directly on the skin to monitor tracks skin and heart conditions. The wireless technology uses thousands of tiny liquid crystals on a flexible substrate to sense heat and turns colors to notify the wearer of a change in conditions.

Status: Evolving

Funding Source/Mechanism: The National Science Foundation supported the research.

2.1.37 Olive

Website: <http://www.witholive.com/>

Technology name: Olive bracelet

Description: This device is designed to help users manage stress by monitoring a user's heart rate, ambient light, and skin temperature to notifying users of rising stress. The bracelet uses either LED lights or haptic feedback to tell users that their stress is rising.

Status: Soon to be available - Design and engineering validation testing in Spring 2015 with a goal for the wearable to be available by November 2015

Funding Source/Mechanism: Crowdfunding

Olive is best used with a smartphone but can be used in standalone mode.

	BRACELET & SMARTPHONE	STANDALONE MODE
DATA TRACKED	Most complete picture of stress. Sensor data fused with smartphone lifestyle data (e.g. location, calendar, etc.). Data can be reviewed in real time on app through bluetooth.	Bracelet sensor data is tracked and can be reviewed via web dashboard.
GUIDED EXERCISES	Wide range of exercises from various disciplines including breathing, meditation, mindfulness, and physical exercises.	Biofeedback-based breathing exercises that get more advanced over time.
SOFTWARE SMARTS	Insights based on biometrics, habit analysis, and lifestyle trends. More personalized and thoughtful recommendations based on personal patterns learned over use.	Insights and stress management recommendations based on bracelet biometrics.

OLIVE SPECS & ACCESORIES

Olive is loaded with hardware and extras.

TECH SPECS

- Modular design with swappable bands
- Aluminum and thermoplastic construction
- Optical pulse sensor
- Skin conductance sensor
- Skin temperature sensor
- Ambient light sensor
- 3-axis accelerometer
- Capacitive touch surface
- LED matrix display
- Haptic feedback
- Li-Po Battery (4 day life estimated)
- Bluetooth 4.0 Low Energy

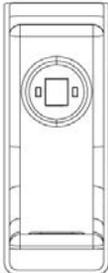


Photo source: <https://www.indiegogo.com/projects/olive-a-wearable-to-manage-stress>

2.1.38 Qardio, Inc.: QardioCore

Website: <https://www.getqardio.com/>

Technology Name: QardioCore wearable ECG monitor

Description: QardioCore is a wearable ECG monitor that collects and transmits biometric data to a smartphone or tablet then pushes automatically to the Qardio Cloud where it is made available to physicians and patients.

Status: Available

Funding Source/Mechanism:

2.1.39 Rjuven: Rejiva®

Website: <https://rjuven.com/rejiva-science>

Technology name: Rejiva®

Description: The water-resistant device analyzes vital signs and biofeedback metrics such as ECG, heart rate, heart rate variability, respiratory rate, sleep position, posture, sleep breathing index, and energy level, and analyzes the state of the Autonomic Nervous System.

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding

2.1.40 Sensogram: SensoTRACK

Website: <http://uk.prweb.com/releases/2014/10/prweb12215093.htm>

Technology name: SensoTRACK wearable biometric earphones

Description: SensoTRACK is an ear-worn device that can monitor a range of health and fitness parameters including heart rate, respiration rate, oxygen saturation and blood pressure, as well as calories, step count, and geophysical location. SensoTRACK can run as a stand-alone device or pair with devices.

Status: Soon to be released - Plans call for limited availability by February 2015 and full-scale production in second quarter of 2015.

Funding Source/Mechanism: Crowdfunding



Photo source:
<http://www.sensogram.com/products/sensotrack>

2.1.41 Sensoria

Website: <http://www.sensoriafitness.com/>

Technology name: Textile Sensors

Description: Sensoria integrates smart biometric monitoring capabilities with sports gear (i.e., socks, t-shirts, sports bra). Textile sensors embedded in the fabric provide information on heart rate, activity, running form, wellness, and fitness levels and allows for remote monitoring that could enable early detection to prevent, manage, and detect falls, foot injuries, or complications.

Status: Available - The fitness gear is available for purchase online. A software development kit is available.

Funding Source/Mechanism: Sensoria (previously known as Heapsylon) recently received an additional \$5 million in investment from Reply SpA as it looks to expand its operations in the U.S. and Europe.

2.1.42 Smartcardia: InnerYou (INYU)

Website: <http://www.thehindu.com/sci-tech/science/indian-researcher-develops-new-device-to-track-status-of-heart/article6557420.ece>

Technology Name: Inner You (INYU)

Description: The hand-held device obtains a combination of physiological signals from the body like ECG, breathing, skin conductance and physical activity to infer the physical and emotional state of the user. Users' biosignals like breathing or heart rate can also be used to controls games.



Photo source: <http://www.smartcardia.com/inyu/>

Status: Evolving

Funding Source/Mechanism:

2.1.43 Spire

Website: <http://www.sys-con.com/node/3241433>

Technology Name: Spire wearable health tracker

Description: Spire is a wearable that measures breathing patterns to make users aware of their focus, tension, and calm levels. The tracker can be worn on the hip or torso and is washer proof. The Spire app notifies the user of significant events and offers guided activities to shift state of mind, such as a breathing exercise or a relaxing walk. The Spire tracker can be worn on the hip or torso is washer proof, and its 7-day battery charges wirelessly on a cork charging pad.

Status: Available for purchase

Funding Source/Mechanism:

2.1.44 Spree: Smartcap

Website: <http://spreewearables.com/>

Technology name: Smartcap

Description: Smartcap uses Spree’s patented biosensor technology in a comfortable wearable cap that measures heart rate, temperature, movement and calories burned. Users pair the monitor with a Bluetooth Smart-enabled device running iOS Version 7 or Android Version 4.4 or higher. The technology is also available in a headband.

Status: Available

Funding Source/Mechanism:

2.1.45 Thync: Vibes

Website: <http://www.thync.com>

Technology name: Thync Vibes neurosignaling wearable device

Description: The device is designed to use neurosignaling to shift a person’s state of mind; electronic or ultrasonic waveforms signal neural pathways in the brain to trigger a shift in the user’s state of mind or energy level.

Status: Soon to be available - Thync is currently working with the FDA for approval.

Funding Source/Mechanism: Thync has raised a total of \$13 million since inception from top-tier investors, including lead investor Khosla Ventures.

2.1.46 University of Buffalo, Sentient Science

Website: <http://www.buffalo.edu/news/releases/2014/11/019.html>

Technology Name: Wearable technology that fuses real-time medical and physiological data with computer models

Description: Researchers are developing wearable technology that fuses real-time medical and physiological data with computer models. The system sends personalized alerts when the individual’s level of stress, fatigue, and resilience may put them in danger. The wireless system will feature a series of electrodes that measure heart rate, brain activity, and other vital signs. The electrodes will relay information to a small sensor attached to the skin that will deliver that information to a remote computer network.

Status: Evolving

Funding Source/Mechanism: The work is funded by a \$150,000 grant from the Office of Naval Research’s Small Business Technology Transfer program.



Sentient Science's Digital Clone software will combine real-time health data with complex computer models to help alert soldiers and civilians when they're in danger.

Photo source: <http://www.buffalo.edu/ub2020/strengths/ora/research-news.host.html/content/shared/university/news/news-center-releases/2014/11/019.detail.html>

2.1.47 University of Cincinnati

Website: <http://www.uc.edu/news/NR.aspx?id=20677>

Technology name: Sweat sensor skin patch

Description: This lightweight, wearable device features a sodium sensor, voltage meter, communications antenna, microfluidics, and a controller chip to analyze sweat via smartphone. The patches use paper microfluidics, “an inexpensive technology similar to that of a home pregnancy test,” to measure biomarkers (electrolytes, metabolites, proteins, small molecules, amino acids) in sweat that signal the physical state of the body.

Status: Evolving - Industry partners are expected to start more extensive human trials with the patch before the end of the year. Pilot program testing on college athletes could begin early next year. A second-generation patch using secure Bluetooth technology is nearly complete.

Funding Source/Mechanism:

2.1.48 University of Memphis

Website: <http://dl.acm.org/citation.cfm?id=2676433>

Technology Name: Kinematic-based activity recognition systems

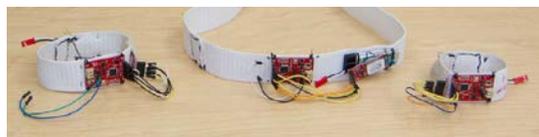


Photo source: <http://dl.acm.org/citation.cfm?id=2676433>

Description: Researchers are designing wearable sensors that use kinematic-based activity recognition systems to identify sedentary and light-intensity activities.

Status: Evolving

Funding Source/Mechanism:

2.1.49 V1bes

Website: <https://www.indiegogo.com/projects/v1bes-a-ring-for-self-diagnostics-against-stress>

Technology Name: V1bes activity monitor ring

Description: V1bes analyzes brainwaves, heart rate and molecular stress from surrounding electromagnetic pollution to measure stress. V1bes detects subtle voltage fluctuations between the sensors skin electrode (under the ring, touching the finger) and the antenna electrode (silver tube). The V1bes app provides real-time measuring of voltage fluctuations and frequency analysis.

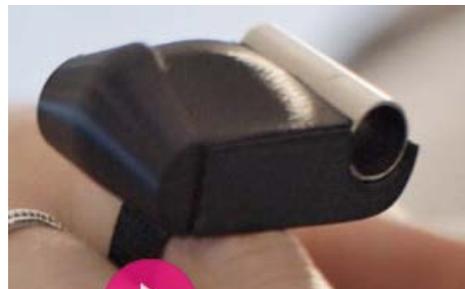


Photo source: <https://www.indiegogo.com/projects/v1bes-a-ring-for-self-diagnostics-against-stress>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.1.50 Valencell: PerformTek

Website: <http://www.valencell.com/performtek%C2%AE-sensor-technology>

Technology name: PerformTek sensor technology

Description: PerformTek-powered sensors are wearable biometric sensors that continuously measure heart rate and activity, body temperature, respiratory rate, and blood pressure and are available in multiple sizes and form factors and comfortably fit into products of all types such as earbuds, sport watches, and armbands. PerformTek sensor technology can be seamlessly integrated into communication devices for first responders.

Status: Available

Funding Source/Mechanism: Since being founded in 2006, Valencell has raised more than \$13 million in venture funding from WSJ Joshua Fund, Best Buy Capital, TDF Ventures and True Ventures. The company has also secured more than \$3 million in grants.

2.1.51 Welch Allyn and Gentag

Website: <http://gentag.com/nfc-skin-patches/>

Technology name: Smart skin patches

Description: Ultra-lightweight, flexible and biosensor disposable skin patches, no thicker than ordinary adhesive bandages, are combined with Gentag near-field communication biosensors to simplify

diagnostics, fitness, diabetes monitoring, and drug delivery. These can be entirely battery-free, powered only by near-field communication and can provide precise geolocation even indoors.

Status:

Funding Source/Mechanism:

2.1.52 Zoll: Life Vest

Website: <http://lifest.zoll.com/>

Technology Name: Zoll Life Vest

Description: The LifeVest wearable defibrillator is worn by patients at risk for sudden cardiac arrest, providing protection during their changing condition and while permanent sudden cardiac arrest risk has not been established.

Status: Available

Funding Source/Mechanism:

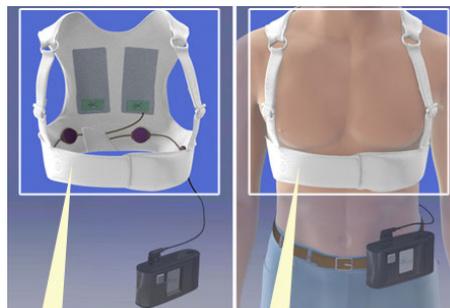


Photo source: <http://lifest.zoll.com/medical-professionals>

2.2 Chemical/Particle

2.2.1 Borre Akkersdijk and Martijn ten Bomer (individuals): BB.Suit 2.0

Website: <http://www.dezeen.com/2014/09/28/bb-suit-air-purifying-garment-byborre-eva-de-laat/>

Technology name: BB.Suit 2.0

Description: BB.Suit 2.0 uses textiles with an “integrated air quality sensor” to analyze and map air pollution, including measuring the concentration of carbon monoxide, methane and liquid petroleum gas. The BB.Suit uses cold plasma technology to create a “bubble of clean air” around the wearer.

Status: Evolving

Funding Source/Mechanism:

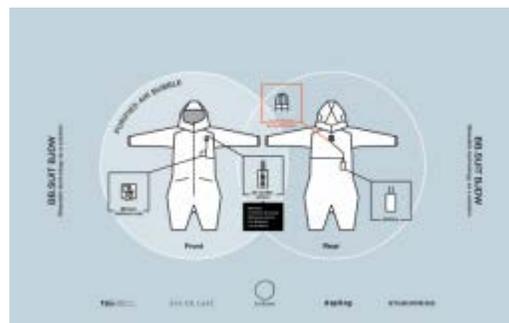


Photo source: http://static.dezeen.com/uploads/2014/09/BB-Suit-2-ByBorre-Eva-de-Laat_dezeen_6_1000.gif

2.2.2 Chemisense

Website: <http://chemisense.co/>

Technology Name: Chemical sensor

Description: A chemical sensor that can detect chemicals present in the air around the user in real time. Chemisense initially plans to release the sensor embedded in a wristband.

Status: Evolving – aiming to have a working prototype within the next six months.

Funding Source/Mechanism:

2.2.3 Frog Shanghai: AirWaves

Website: <http://www.frogdesign.com/work/frog-wearables.html>

Technology name: AirWaves pollution mask

Description: A pollution mask that filters air pollution and monitors the air quality, sharing the collected data with other mask users via a smartphone app.

Status: Evolving

Funding Source/Mechanism:

2.2.4 HabitatMaps: AirBeam

Website: <http://www.takingspace.org/>

Technology Name: AirBeam wearable air monitor

Description: The palm-sized monitor measures particulate pollution, temperature, and humidity. The AirBeam uses a light-scattering method to measure PM2.5. Air is drawn through a sensing chamber where light from an LED bulb scatters off particles in the airstream. This light scatter is registered by a detector and converted into a measurement that estimates the number of particles in the air and communicates these measurements via Bluetooth to the AirCasting Android app.



Photo source: <https://www.kickstarter.com/projects/741031201/airbeam-share-and-improve-your-air>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.2.5 Morphix Technologies: Chameleon

Website: <http://www.morphitec.com/products/chameleon/overview/>

Technology name: Chameleon

Description: The wearable device allows hands-free detection of up to 10 different chemical hazards at one time. The product is approved by the US SAFETY Act of the DHS as an anti-terrorism technology.

This low-cost, reusable armband can hold up to 10 cassettes, each of which detect a particular toxic chemical and changes color upon detection. The product is anticipated to help military and first responders at the scenes of terrorist events and natural disasters to quickly and reliably detect any invisible toxic chemicals that may be present in the air.



Photo source: <http://www.morphtec.com/products/chameleon/overview/>

Status: Available

Funding Source/Mechanism:

2.2.6 Nanozen

Website: <http://nanozen.ca/>

Technology name: Wearable particle sensor

Description: The wearable particle sensor was designed for use in mines, mills, and other industrial locations where dust and other particles can lead to respiratory diseases. The monitor can detect particles as small as one micron and attach to protective equipment such as a helmet.

Status: Soon to be released - Currently field testing with hopes to launch the product in 2015.

Funding Source/Mechanism: The startup has been financed through government grants and private angel funding.

2.2.7 NTT Docomo: Docotch

Website: <https://www.nttdocomo.co.jp/english/>

Technology Name: Docotch

Description: A safety-conscious children's smartwatch designed by Japanese mobile phone operator NTT Docomo, the Docotch has the ability to measure air quality in the home. The device is equipped with humidity and temperature sensors, which may aid in preventing heat-related ailments such as heatstroke. Key features also include air monitoring, GPS tracking, 3G communications, and a panic button that sends an alert with a location tag by email to up to six stored numbers.

Status: Soon to be released - due to be released in May 2015

Funding Source/Mechanism:

2.2.8 TZOA: Enviro Tracker

Website: <https://www.kickstarter.com/projects/tzoa/meet-tzoa-the-worlds-first-enviro-tracker>

Technology Name: TZOA Enviro-Tracker

Description: TZOA measures harmful air pollution metrics and builds street-level maps of community air quality. TZOA uses an optical air quality sensor to detect UV rays and particle matter in the air. The sensor counts individual particles, displays concentrations, and distinguishes between PM10, which tends to be allergens, and PM2.5, which is more harmful

to human health. TZOA's data will stream onto the TZOA Smartphone App and then further processed in the cloud.



Photo source: <http://www.mytzoa.com/>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

2.2.9 UC Berkeley: Clarity

Website: <http://clarity.io/>

Technology Name: Clarity wearable air quality monitor

Description: Clarity is a small wearable device that measures air pollutants including particulate matter 2.5, volatile organic compounds, nitrogen dioxide, and ammonia. The device also measures temperature and humidity. Clarity uses sensors that operate as pollution detectors. Users receive real-time alerts of pollution levels and notifications of the optimal times to be outdoors or engage in strenuous physical activities



Photo source:
<http://clarity.io/>

Status: Evolving

Funding Source/Mechanism:

2.2.10 WindSix

Website: <http://springwise.tumblr.com/post/102448200558/in-china-this-wearable-air-purifier-could-replace>, www.any-air.cn (in Chinese)

Technology Name: Intelligent Wearable Air Purifier

Description: Wind Six developed a wearable air purifier that uses a powerful, high-precision filter that purifies the air around it by up to 99.9%, even in strong winds. It looks similar to a headset and uses non-ozone electrostatic dust removal technology. The battery runs for around 6 to 8 hours on a single charge.

Status: Evolving

Funding Source/Mechanism:

2.3 Other

2.3.1 Bionym: Nymi

Website: <http://www.getnyimi.com/>

Technology name: Nymi

Description: The wristband uses an electrocardiogram (ECG) sensor to recognize a user's heart rhythm and automatically unlock a device. Nymi's ECG sensor measures the electrical activity the heart generates, which is "as unique as a finger print."

Status: Soon to be released

Funding Source/Mechanism: The company announced a \$14 million Series A led by Ignition Partners and Relay Ventures.

2.3.2 Captiks: Movit

Website: <http://www.captiks.com/en/>

Technology name: Movit – miniature unit for motion capture

Description: The Italian start-up Captiks develops wearable, wireless devices that measure body motions for kinematic and functional analysis. Its modular devices are equipped with several sensors, such as accelerometer, gyroscope, magnetometer, and barometer.

Status: Evolving

Funding Source/Mechanism:

2.3.3 Sail Research: Pathfinder

Website: <http://www.sailresearch.com/pathfinder.html>

Technology name: Pathfinder

Description: A small, light wristband translates sight into touch, allowing blind and visually impaired users to rapidly scan and identify any environment. Gentle taps encode highly accurate environmental detail, indicating any object up to 10 feet away. Pathfinder offers long ranges (up to 10 feet), contact-free sensing, and full control of both hands.

Status: Evolving

Funding Source/Mechanism: Crowdfunding



Photo source:
<https://www.kickstarter.com/projects/1817086720/pathfinder-wearable-navigation-for-the-blind>

2.3.4 Samsung: Simband

Website: <http://blog.phonebloks.com/post/102863040618/samsung-simband-a-modular-wearable-platform-for>

Technology Name: Simband modular smartband

Description: Simband is an open developer platform comprising a smartwatch unit and a wristband connector that holds custom sensor modules. Developers can modify, build, and integrate their own custom modular health sensors. The smartband is based on the Samsung Architecture Multimodal Interactions (Sami) health platform, an open cloud network that shares data from wearable devices or online sources to other gadgets or applications in real time. Simband is not currently a consumer product; it is a reference design for developers to use to start creating their own modules and apps.



Photo source:
<http://blog.phonebloks.com/post/102863040618/samsung-simband-a-modular-wearable-platform-for>

Status: Available

Funding Source/Mechanism:

3.0 Displays

3.1 Heads-Up

3.1.1 Ashkelon Enterprises

Website: <http://www.ashkelon-visor.com/>
<http://www.augmentedrealitytrends.com/wearable-technology/ashkelon-visor.html>

Technology Name: Ashkelon Visor

Description: The Ashkelon Visor prototype features a front compartment for a smartphone and a Focusing Relay unit. Touching the Smartphone and other movements control the menu selection process. The functions appear in the Focusing Relay via smartphone.



Photo source: <http://www.ashkelon.me/>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

3.1.2 Atheer Labs

Website: <https://www.atheerlabs.com/>

Technology name: Augmented reality glasses

Description: Atheer's glasses overlay information over the real world and allow the user to manipulate digital fields or content with hand gestures. A sensor built into the pair of glasses picks up the shape of the user's hands, swiping, or clicking on an augmented reality button.

Status: Soon to be released - Atheer has a development kit shipping to early partners, with a broader release planned for next year.

Funding Source/Mechanism: Crowdfunding

3.1.3 DAQRI

Website: <http://www.coolwearable.com/daqri-smart-helmet/>

Technology Name: DAQRI Smart Helmet

Description: The smart helmet is fitted with augmented reality. It utilizes a 4D interface to allow users to see content and touch/control using third-party devices like a smartwatch. The device features an industrial-grade inertial measurement unit, a high resolution 3D depth camera, and 360° navigation



Photo source:
<http://hardware.daqri.com/smarthelmet/>

cameras. It supports HD video recording, mapping, and more. The device uses a technology called Intellitrack capable of recognizing specific objects and environments and even reconstructing a facility or building based on plans.

Status: Soon to be released

Funding Source/Mechanism:

3.1.4 Elbit Systems: Skylens™

Website:

[https://www.elbitsystems.com/elbitpr/files/Frost%20Sullivan Awarded f or Skylens Wearable Head-Up Display.pdf](https://www.elbitsystems.com/elbitpr/files/Frost%20Sullivan%20Awarded%20for%20Skylens%20Wearable%20Head-Up%20Display.pdf)

Technology name: Skylens Wearable heads-up display

Description: The Skylens wearable heads-up display was designed for commercial pilots to provide a better view through augmented vision that can help them navigate through fog and darkness. Skylens is a lightweight wearable device with a visor large enough to fit easily over the pilot's glasses and display high-resolution data, symbols, and video. It reduces dependency on airport equipment, enhances day and night operation in all weather conditions and provides exceptional situational awareness.



Photo source:
<http://www.gizmag.com/skylens-hud-elbit/31945/pictures#2>

Status: Evolving

Funding Source/Mechanism:

3.1.5 Fusar Technologies: Guardian

Website: <http://www.autoevolution.com/news/ride-safe-wearing-the-guardian-ga-1-worlds-smartest-helmet-video-81920.html>

Technology Name: Guardian GA-1 augmented reality motorcycle helmet

Description: The Guardian is a U.S. Department of Transportation approved device with an Android board, two wide-angle cameras, and parts of the Epson Moverio Glasses. Bikers receive speed, fuel and navigation data as well as information about their surroundings, side and rear included. The prototypes may also include additional alerts and voice control.

Status: Evolving

Funding Source/Mechanism: Crowdfunding

3.1.6 Google

Website: http://www.dubaipolice.gov.ae/dp/jsps/media/news_details.do?newsId=87103

Technology name: Google Glass with customized software

Description: Software developed by Dubai police for use with Google Glass will allow for facial recognition. The software will establish a connection between devices disseminated amongst its detectives and a database of wanted people. Google Glass will be able to match suspects to any existing profiles based on their face print.

Status: Soon to be released. The device, which is expected to cost £1000 when it goes on wide release next year.

Funding Source/Mechanism:

3.1.7 I2i: iPal

Website: <http://meetipal.com>

Technology name: iPAL glasses

Description: iPal glasses have four cameras embedded in the frame. Two eye-tracking cameras see what the user sees, and two HD cameras view the scene in front of the eyes and can also zoom. iPal uses eye gestures as a control mechanism, allowing a hands-free, attention-free experience. iPal works with Android, iOs or Windows smartphones with apps that can deliver telepresence, driver assistance, and image recognition and retail searches.



Photo source: <http://meetipal.com/>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

3.1.8 Magic Leap: Dynamic Digitized Lightfield Signal™

Website: <http://www.magicleap.com/#/home>

Technology name: Dynamic Digitized Lightfield Signal™

Description: Magic Leap's augmented-reality technology is alleged to generate images indistinguishable from real objects and place those images seamlessly into the real world, essentially creating realistic 3D light sculptures before the user's eyes. Patent and trademark filings describe sophisticated display technology that can trick the human visual system better than existing virtual reality displays into perceiving virtual objects as real.

Status: Evolving – patents filed

Funding Source/Mechanism: Magic Leap received \$542 million Series B financing from Google Inc., with participation from Qualcomm Incorporated, through its venture investment group, Qualcomm Ventures, Legendary Entertainment, including a personal investment from CEO Thomas Tull, KKR, Vulcan Capital, Kleiner Perkins Caufield & Byers, Andreessen Horowitz, Obvious Ventures, and other

investors. Magic Leap also raised more than \$50 million in its series seed and A rounds to develop its proprietary technology platform.

3.1.9 Mitsumi

Website: <http://www.ubergizmo.com/2014/10/mitsumi-delivers-focus-free-wearable-display/>

Technology name: Laser eyewear

Description: This prototype laser eyewear with a focus-free display is a retina-scanning display that relies on RGB laser and MEMS mirror. These transparent wearable glasses deliver a wide viewing angle, a high level of brightness, and decent color reproducibility.

Status: Evolving

Funding Source/Mechanism:



Photo source: <http://www.ubergizmo.com/wp-content/uploads/2014/10/mitsumi-focus-free-display-2.jpg>

3.1.10 NUVIZ

Website: <http://www.gadgetify.com/nuviz-ridehud-heads-up-display-for-motorcycle-helmets/>
<http://www.ridenuviz.com/>

Technology Name: NUVIZ

Description: NUVIZ is a heads-up display system for motorcycle helmets that attaches to the chin bar of the user's helmet and uses Liquid Crystal on Silicone Microdisplay to offer a clear experience. NUVIZ provides navigation, weather, telemetry, and other useful information and allows the user to capture photos, stay connected, and listen to music.

Status: Evolving

Funding Source/Mechanism: Crowdfunding



Photo source: <https://www.kickstarter.com/projects/nuviz/the-first-head-up-display-for-motorcycle-helmets/?ref=kicktraq>

3.1.11 Optinvent: Ora

Website: <http://optinvent.com/>

Technology name: Ora

Description: Ora X features a front-facing 1080p 5MP camera, a 9-axis motion sensor, wireless connectivity with Bluetooth, Wi-Fi and GPS as well as a trackpad for tactile interactions. Compared to Google Glass, Ora provides a Flip-Vu mode that allows the image to be either directly in the wearer's field of view or just below.

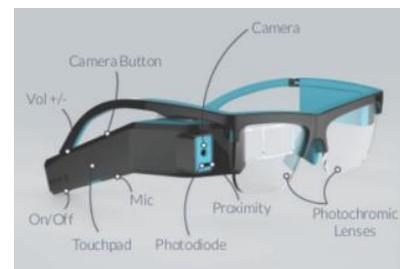


Photo source: <http://optinvent.com/http://optinvent.com/>

Status: Soon to be released. Preorders are being taken. It is not an FCC, UL, CSA, or CE approved product for general consumers

Funding Source/Mechanism: Crowdfunding

3.1.12 Recon Instruments: Snow2

Website: <http://www.reconinstruments.com/products/snow2/>

Technology name: Snow2 heads-up display

Description: Goggles that display detailed information including speed, jump analytics, altitude, map, compass, messaging capabilities and markers showing the location of others on the slopes. The Snow 2 holds a dual-core CPU, GPS, and on-board gyroscope, accelerometer, magnetometer, altimeter, and thermometer.



Photo source:
<http://www.reconinstruments.com/products/snow2/>

Status: Available

Funding Source/Mechanism:

3.1.13 SAP and Vuzix

Website: <http://www.eweek.com/innovation/sap-teams-with-vuzix-on-new-apps-for-video-eyewear.html>

Technology name: Video eyewear

Description: The smart glasses combine SAP's augmented reality (AR) apps with Vuzix's M100 glasses. The new AR applications, SAP® AR Warehouse Picker and the SAP® AR Service Technician, simplify and improve the user experience and work processes by offering a hands-free working experience. The wearer interacts with the device using voice commands. In a warehouse for example, the device frees warehouse workers from handheld scanners and other devices.

Status:

Funding Source/Mechanism:

3.1.14 Skully

Website: <http://store.skullysystems.com/>

<http://www.coolwearable.com/skully-helmet-google-glass-motorcycles/>

Technology Name: Augmented reality motorcycle helmet

Description: The Skully AR-1 helmet is a light, high-quality, and full-faced motorcycle helmet equipped with a wide-angle rearview camera and transparent heads-up display. The helmet provides riders with navigation, blind spot information, 180-degree rear-view camera.

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding

3.1.15 Sony: SmartEyeglass

Website: <https://developer.sony.com/devices/mobile-accessories/smarteyeglass/>

Technology name: SmartEyeglass

Description: SmartEyeglass is equipped with a range of different sensors, electronic compass, gyroscope, accelerometer, ambient light sensor, and 3-megapixel camera. It is wired to an external battery pack equipped with a microphone and added touch sensor.



Status: Soon to be released - Sony released the software development kit for this wearable technology and stated that by the end of March 2015 the hardware kits will also be ready for developers to purchase.

Photo source:
<https://developer.sony.com/devices/mobile-accessories/smarteyeglass/>

Funding Source/Mechanism:

3.1.16 TrackingPoint: ShotGlass™

Website: <http://tracking-point.com/how-it-works/shotglass>

Technology name: ShotGlass

Description: TrackingPoint's ShotGlass™ app on the Recon Jet™ smartglass allows the wearer to see and record what their compatible Tracking Point scope sees. ShotGlass features a high-definition video display, an HD camera that can record audio and video, and optical controls that allow the user to control the glasses even when wearing thick gloves. ShotGlass only works with TrackingPoint's Precision Guided Firearms, which can tag, track and automatically fire at targets more than 1,000 yards away.

Status: Soon to be released

Funding Source/Mechanism:

3.1.17 University of Fukui

Website: <http://spie.org/x110607.xml>

Technology name: Laser beam combiner

Description: This technology could offer immediate, hands-free access to information via gadgets such as smart glasses, which overlay computer-generated visual data on the user's field of vision. The small laser beam combiner enables laser-scanning displays in wearable computer systems. The beam combiner comprises three optical waveguides for RGB light inputs, as well as three directional couplers. The couplers can switch and exchange the light beams from one to the other,

Status: Evolving

Funding Source/Mechanism:

3.2 Body-worn

3.2.1 Arubixs: Portal

Website: <http://www.arubixs.com/>

Technology name: Portal, flexible screen phablet

Description: Portal is a flexible screen phablet that slides into a dual-strap arm cradle that extends about halfway up the forearm from the wrist. The device's 6-inch TFT display is scratch-resistant and reinforced by a flexible Kevlar exterior. It has 2GB RAM, a total of four cameras, 64GB of storage, a full suite of sensors, NFC, Bluetooth, LTE, wireless charging and a proprietary 3,200mAh flexible battery. Portal will run a skinned version of Android and respond to touch, gesture, and motion-based commands.



Photo source: <https://www.indiegogo.com/projects/portal-by-arubixs-flexible-wearable-smartphone>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

3.2.2 Cricet

Website: <http://proctorfree.com/blog/week-cheating-november-25th-cicret-wearable-technology>,
http://www.cicret.com/wordpress/?page_id=17920

Technology Name: Cicret bracelet and on-skin display

Description: The Cicret (pronounced secret) app connects to a bracelet, a wearable technology, that projects your smartphone on your forearm. You can control and move through the app by touching your skin as you would the screen of the device.



Photo source:
http://www.cicret.com/wordpress/?page_id=17920

Status: Evolving.

Funding Source/Mechanism: Crowdfunding

3.2.3 Kyocera: Proteus

Website: <http://www.igyaan.in/88518/kyocera-proteus/>

Technology Name: Proteus collapsible, wearable smartphone

Description: This flexible device collapses to become a wearable. The device can transform from a flat, bar-shaped phone into a bracelet that can be draped or wrapped around. The Proteus is expected to have AMOLED display.

Status: Evolving

Funding Source/Mechanism:



Photo source:
<http://www.igyaan.in/88518/kyocera-proteus/>

3.2.4 Proglove

Website: <http://www.proglove.de/>

Technology name: Proglove

Description: This professional-grade wearable tool targeted at professional production processes features Intel-Edison sensors in the fingers, a computing core and display. ProGlove enables its wearer to work faster, more accurately and more efficiently, plus it is easy to use and unlocks a new level of control and business intelligence for production management.

Status: Evolving

Funding Source/Mechanism: \$100,000 award from Intel Make it Wearable campaign.



Photo source:
<http://press.proglove.de/>

4.0 Power

4.1 Chargers/Batteries

4.1.1 BAE Systems: Broadsword

Website:

http://www.baesystems.com/product/BAES_176721/broadsword

Technology name: Broadsword

Description: Broadsword product line features interconnecting components such as inductive charging equipment pouches that provide power to equipment batteries without wiring/connections.

Status: Evolving

Funding Source/Mechanism: U.S. Army

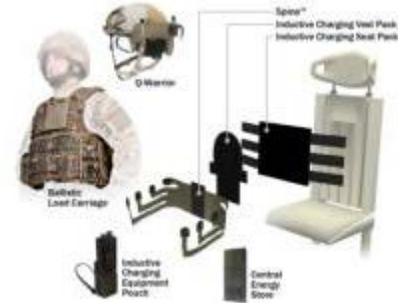


Photo source:
http://www.baesystems.com/cs/groups/public/documents/digitalmedia/mdaw/mtkz/~edisp/~extract/BAES_176880-1~staticrendition/748x421.jpg

4.1.2 Korea Advanced Institute of Science and Technology: Dipole Coil Resonant System

Website: http://www.eurekalert.org/pub_releases/2014-04/tkai-wpt041714.php

<http://www.businesskorea.co.kr/article/6829/wireless-power-commercialization-wireless-power-charging-wearable-implanted-devices-be>

Technology name: Wireless charging system using Dipole Coil Resonant System (DCRS)

Description: KAIST is developing a wireless power transmission technology called DCRS that reduces the required number of coils to a single transmitter and single receiver coil (only 10 percent of the size of the originals) by using dipole-structured high-frequency magnetic substances. Due to less fluctuation in the low frequency used, DCSR is 20 times sturdier against changes in the environment and much more efficient at the same time. Researchers developed a wireless charging system using the technology that can charge around 40 smart phones at a time, from a distance of 5 meters.

Status: Evolving

Funding Source/Mechanism: Ministry of Science, ICT & Future Planning

4.1.3 Nifty: XOO

Website: <http://en.kioskea.net/news/25565-xoo-belt-phone-charging-wearable>

Technology Name: XOO

Description: The XOO belt includes 2,100 mAh of power to allow



Photo source: <https://www.indiegogo.com/projects/xoo-belt-by-nifty-a-phone-charging-belt>

users to charge up on the go. Devices can plug into the belt to charge. The belt features a Lithium Ceramic Polymer flexible battery and is weather-resistant. The charging wire is magnetically nestled against the inside of the belt when not in use.

Status: Evolving

Funding Source/Mechanism: Crowdfunding

4.1.4 Panasonic

Website: <http://news.panasonic.com/press/news/official.data/data.dir/2014/10/en141003-2/en141003-2.html>

Technology name: Pin-shaped Lithium ion battery

Description: This small cylindrical-shaped rechargeable Lithium ion battery (a diameter of 3.5mm and a weight of 0.6g) features the high reliability and high output required for near-field communications and may be a fit power source for small devices such as spectacles-shaped, pen-shaped and other slim devices.

Status: Soon to be released - February 2015

Funding Source/Mechanism:

4.1.5 Samsung

Website: <http://www.digitaltrends.com/wearables/samsung-flexible-battery/>

Technology name: Bendable battery and pill-sized battery

Description: Samsung's thin, rollable, bendable battery can wrap around a person's wrist or bend into a U shape and still operate normally. Samsung also announced a tiny pill battery with the capacity up to 5 times higher than any batteries mounted to the smart bands rolled out to the markets until now.

Status: Evolving

Funding Source/Mechanism:



Photo source: <http://www.samsungsdi.co.kr/about-sdi/pr-center/sdi-news/view?mode=&pageno=1&seqno=1681&key=&keyword=>

4.1.6 UBeam

Website: <http://ubeam.com/>

Technology name: Ultrasound charger

Description: This device converts electricity into sound that is transmitted via ultrasound. A receiver attached to a portable electronic device catches the sound and converts it back into electricity. Charging stations will be thin, measuring no more than 5 millimeters thick, and smartphones and laptops could be equipped with thin receivers able to convert audio and charge the devices.

Status: Soon to be release – within next two years

Funding Source/Mechanism: Closing a Series A round of financing, in addition to an earlier \$1.7 million seed round from Marissa Mayer, Yahoo’s chief executive; Founders Fund; and Andreessen Horowitz.

4.2 Self-powering/Harvesting

4.2.1 A*STAR Institute of Microelectronics (IME)

Website: <http://www.a-star.edu.sg/Media/News/Press-Releases/ID/2544/Harvesting-Vibrations-To-Power-Microsensors.aspx>

Technology name: Implantable energy harvester

Description: This technology uses low-frequency vibrations to power small-scale electronic devices. MEMS microfluidics and piezoelectric micro-belts convert changes in pressure (from random real-world vibrational sources) into electricity indefinitely. The technology could efficiently harness low frequency vibrations as infinite power source for miniature electronic devices. As an inexorable power supply, the remarkable power density feature translates into massive savings.

Status: Evolving

Funding Source/Mechanism:

4.2.2 AMPY

Website: <http://www.getampy.com/>

Technology name: AMPY wearable kinetic device

Description: The AMPY wearable kinetic device lets users capture and convert physical activity into charging power for smartphones. The compact device straps to a user’s arm, leg, or hip, or is carried inside a personal bag or purse, where it charges when movement is detected. It features Proto Lab’s proprietary architecture for the internal conductor.



Photo source: <http://www.getampy.com/pre-order>

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding, two accelerator programs

4.2.3 Columbia Engineering and the Georgia Institute of Technology

Website: <http://engineering.columbia.edu/researchers-develop-world%E2%80%99s-thinnest-electric-generator>

Technology name: Piezoelectric nanogenerators

Description: Researchers discovered a way to create electricity using an atom-thin generator that produces electricity when bent or stretched and could potentially be sewn into clothing and even used in medical implants. Potential uses include integrated into wearable devices and clothing, converting energy from body movement to electricity, and powering wearable sensors, medical devices, or smartphones.

Status: Evolving

Funding Source/Mechanism:

4.2.4 Fudan University, China

Website: <http://www.polymer.fudan.edu.cn/polymer/research/Penghs/data/publications/101.pdf>
doi: 10.1002/aenm.201401438

Technology name: Wearable supercapacitor textile

Description: Scientists at the Fudan University in Shanghai, China, developed a high-performance Li-ion battery made of carbon nanotube fiber yarns. The novel wearable supercapacitor textile is thin, lightweight, transparent, and flexible and developed by stacking two aligned carbon nanotube fiber-based textile electrodes. The supercapacitor textile is further integrated to create a new energy textile that can convert solar energy to electric energy, in addition to storing it with a high entire photoelectric conversion and storage efficiency.

Status: Evolving

Funding Source/Mechanism:

4.2.5 Georgia Institute of Technology

Website: <http://pubs.acs.org/doi/abs/10.1021/nl5029182>

Technology Name: Self-powered nanosystem

Description: According to this research by Pradel, Wu, Ding, and Wang (2014), self-powered nanosystems that harvest operating energy from a host (i.e., the human body) may be feasible due to their extremely low power consumption. Researchers report materials and designs for wearable-on-skin piezoelectric devices. According to this research, the p–n structure can be further grown on polymeric substrates conformable to a human wrist and used to convert movement of the flexor tendons into distinguishable electrical signals for gesture recognition. The devices may have applications in powering nanodevices, bioprobes, and self-powered human–machine interfacing.

Status: Evolving

Funding Source/Mechanism:

4.2.6 Korea Advanced Institute of Science and Technology

Website:

http://www.kaist.ac.kr/_prog/_board/?code=ed_news&mode=V&no=17562&upr_ntt_no=17562&site_dvs_cd=en&menu_dvs_cd=0601

Technology name: Glass fabric-based flexible thermoelectric (TE) generator

Description: The light-weight, flexible glass fabric-based thermoelectric (TE) generator is light-weight, extremely flexible, and produces electricity from the heat of the human body. This will be useful for wearable self-powered mobile electronic systems such as medical sensors or smart watches.



Photo source:
http://www.kaist.ac.kr/_prog/_board/?code=ed_news&mode=V&no=17562&upr_ntt_no=17562&site_dvs_cd=en&menu_dvs_cd=0601

Status: Evolving

Funding Source/Mechanism:

4.2.7 Pauline Van Dongen: Wearable Solar

Website: <http://dutchdesigndaily.com/new/wearable-solar/?cat=4>

Technology Name: Wearable solar

Description: Wearable Solar comprises two designs that produce sustainable energy through integrated solar cells. When worn in full sun for 2 hours, the garments can generate enough energy to charge a typical smartphone. The solar cell compartments can be opened and revealed to the sun when needed and folded back when they are not being used.



Photo source:
<http://paulinevandongen.nl/projects/wearable-solar/>

Status:

Funding Source/Mechanism:

4.2.8 Rajesh Adhikari (Individual)

Website: <http://tech.firstpost.com/news-analysis/12th-class-indian-boy-builds-a-waterproof-shoe-that-charges-phones-as-you-walk-220187.html>

Technology name: Power-generating footwear

Description: These functional shoes contain a small dynamo that charges up and produces 5 volts of electricity as the wearer walks or runs; this can light up an LED bulb when the power runs out or charges a mobile phone.

Status: Evolving

Funding Source/Mechanism:

4.2.9 Sungkyunkwan University: Perovskite Solar Cells

Website: http://skkuchemeng.hosting.bizfree.kr/xe/index.php?document_srl=559228&mid=news01 DOI: 10.1039/c4ee02441a

Technology name: Perovskite Solar Cells

Description: According to this research, perovskite solar cells may provide an efficient, flexible, and lightweight energy supply system for wearable devices. The cells may provide high power conversion efficiency while using a low-temperature technology for the fabrication of a compact charge collection layer.

Status: Evolving

Funding Source/Mechanism:

4.2.10 Tommy Hilfiger

Website: <http://www.forbes.com/sites/rachelarthur/2014/11/20/tommy-hilfigers-solar-powered-jacket-wearable-tech-in-review/>

Technology Name: Solar-powered jacket

Description: The clothing charges electronic devices by converting energy from solar panels attached to the user's backs. A subtle cord in the lining connects the removable solar panels on the jacket's backside to a removable battery pack in the front right pocket. The solar panel unit is made from a flexible amorphous silicon technology, developed by Pvilion – a specialist in designing and manufacturing lightweight, portable solar products. When exposed to full sunlight, the cells charge up the battery pack which, in turn, can fully charge a standard 1500mAh mobile device up to four times. There are two USB ports on the pack to connect multiple devices at once.



Photo source:
<http://usa.tommy.com/shop/en/thb2cus/women/JACKETS-OUTERWEAR-WOMEN/7655931%20>

Status: Available

Funding Source/Mechanism:

4.2.11 U.S. Marine Corps Expeditionary Energy Office (E2O): Marine Austere Patrolling System

Website: <http://www.onr.navy.mil/en/Media-Center/Press-Releases/2013/MAPS-Marine-Solar-Power-System.aspx>

<http://www.popularmechanics.com/technology/military/news/a-better-way-to-power-our-troops-breakthrough-awards-2014>

Technology name: Marine Austere Patrolling System, or MAPS

Description: MAPS is a wearable solar-energy system can reduce up to 50% of the weight that U.S. Marines normally bears above the waist. The unit comprises a solar energy harvesting and storage system and water-purification unit. MAPS uses a photovoltaic panel and rechargeable battery that weighs less than 3 pounds. The panel works in a transparent sleeve on the vest or can be taken out for maximum exposure to the sun.

Status: Field testing. Over the next 2 years, MAPS will undergo bulletproofing and joint Army–Marine testing to prepare it for use in battle.

Funding Source/Mechanism:

4.3 Power Supply

4.3.1 Acticheck Assure

Website: <http://www.plusplasticelectronics.com/SmartFabricsTextiles/assure-medial-monitor-band-promises-two-year-battery-life-123934.aspx>

Technology Name: Assure

Description: The device provides is a battery life of two years without recharging.

Status: Soon to be released

Funding Source/Mechanism:

4.3.2 Drexel University, Dalian University of Technology: Mxenes

Website: <http://drexel.edu/now/archive/2014/November/flexible-MXenes/>

Technology Name: Mxenes, electrically conductive, flexible nanomaterial

Description: According to this research, engineers chemically engineered a new, electrically conductive nanomaterial that is flexible enough to fold but strong enough to support many times its own weight. Researchers believe it can be used to improve electrical energy storage, water filtration, and radiofrequency shielding in technology from portable electronics to coaxial cables. This flexible new material is a conductive polymer nanocomposite that can be rolled into a tube, which early tests indicate only serves to increase its mechanical strength.

Status: Evolving

Funding Source/Mechanism:



Photo source:
<http://www.drexel.edu/now/archive/2014/November/flexible-MXenes/>

4.3.3 Massachusetts Institute of Technology (MIT)

Website: <http://hdl.handle.net/1721.1/90565>

Technology name: Stretchable supercapacitors with graphene paper

Description: Stretchable supercapacitors can store energy for flexible electronic devices. Crumpled-graphene papers present a simple and low-cost method for extremely stretchable and high-performance electrodes for supercapacitors. Researchers demonstrated that by crumpling a sheet of graphene paper, they can make a supercapacitor that can easily be bent, folded, or stretched to as much as 800 of its original size. The crumpled graphene material might be used as one electrode in a flexible battery, or to make a stretchable sensor for specific chemical or biological molecules.

Status: Evolving

Funding Source/Mechanism: The work was supported by the Office of Naval Research, the National Science Foundation, and the National 1000 Talents Program of China.

4.3.4 Mixel

Website: https://www.mixel.com/pdf/2014/Kopin_MXL_D_PHY_2014.pdf

Technology name: Controller

Description: Mixel's high-performance, low-power Rx D-PHYSM and Northwest Logic's full-featured, small-size CSI-2 Rx Controller Core. The device minimizes power and area.

Status: Available

Funding Source/Mechanism:

4.3.5 Samsung

Website: <http://www.patentlymobile.com/2014/10/samsung-invents-wearable-devices-for-energy-sharing-network.html>

Technology name: Wearable energy sharing devices

Description: Samsung's invention shares energy between wearable devices. The device wirelessly transmits and receives power to enable energy sharing between the plurality of wearable devices. The wearable device may perform wireless energy transmission using a magnetic near field channel in a near field at high efficiency without being affected by a body medium.

Status: Evolving – patent application filed

Funding Source/Mechanism:

4.3.6 Taiwan Semiconductor Manufacturing Company Limited

Website:

<http://www.tsmc.com/tsmcdotcom/PRListingNewsAction.do?action=detail&newsid=8861&language=E>

Technology name: Ultra low-power technology platform

Description: Taiwan Semiconductor Manufacturing Company Limited's ultra-low power processes can reduce operating voltages by 20% to 30% to lower both active power and standby power consumption and enable significant increases in battery life (by 2 to 10 times). Low-power radio frequency and embedded Flash memory capabilities enable system-level integration for smaller form factors as well as facilitating wireless connections among IoT products.

Status: Soon to be released

Funding Source/Mechanism:

4.3.7 TE Wearables Lab

Website: <http://www.hmgaerospace.com/news/show/7973>

Technology Name: Wireless power development kit

Description: The kit will include a small 2.5W charger with integrated magnet for attachment to a wearable device, as well as a complete RX coil and electronics for integration. TE engineers miniaturized the electronic system and the coil to make it possible for wearable designers to prototype their products quickly.

Status: Available

Funding Source/Mechanism:

5.0 Integrated Communications

5.1 Bluetooth

5.1.1 OnBeep: Onyx

Website: <http://wearableworldnews.com/2014/11/06/onbeep-reveals-onyx-wearable-communicator/>

<http://pando.com/2014/11/05/onbeep-launches-onyx-a-simple-wearable-two-way-voice-communication-device-that-pairs-with-your-smartphone/>

Technology Name: Onyx wearable communicator badge

Description: The Onyx is a small, round clip-on wearable equipped with speakers, an LED light, and an activation button that allows users to communicate with other Onyx owners via Bluetooth. Onyx wearers can manage the groups they want to communicate with through the companion smartphone app, and the actual communication occurs through the smartphone's data connection.



Photo source: <http://www.onbeep.com/>

Status: Soon to be released.

Funding Source/Mechanism: Venture funding - The company raised \$6.8 million across two rounds of angel and venture capital.

5.1.2 Yak Hat

Website: <https://www.indiegogo.com/projects/yak-hats-wearable-bluetooth-technology>

Technology Name: Yak Hat

Description: Yak Hat has controls, ear buds, and controls as well as Bluetooth 4.0 integrated into the hat to provide wireless connectivity to the user's Smartphone. The Yak Hat's design also eliminates wind noise during phone conversations in wind speeds up to 40 mph.

Status: Evolving

Funding Source/Mechanism: Crowdfunding



Photo source: <https://www.indiegogo.com/projects/yak-hats-wearable-bluetooth-4-0-technology>

5.2 Hands-free operation

5.2.1 16Lab: OZON™

Website: <http://16lab.net/>

Technology name: OZON™ Smart ring

Description: A titanium ring with dual touch surfaces that can pair with devices via Bluetooth and can interpret gestures, provide alerts, and serve as an e-wallet. The ring features a Sensor Network Module from Alps Electric, a 6mm square chip that integrates Bluetooth 4.0, accelerometer, and compass.

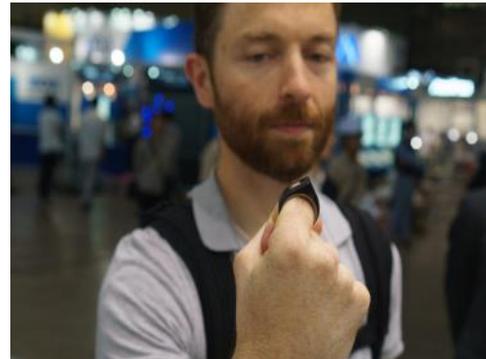


Photo source: <http://16lab.net/>

Status: Soon to be released - 2015

Funding Source/Mechanism:

5.2.2 Easier to Use LLC: GoGlove

Website: <http://www.foxnews.com/tech/2014/11/24/wearable-tech-puts-smartphone-control-at-your-fingertips/>

Technology Name: GoGlove wireless remote

Description: GoGlove is a wearable wireless devices that allows the user to control their smartphone via a Bluetooth module in the glove connected to sensors in the fingertips.



Photo source:
<http://www.goglove.io/http://www.goglove.io/>

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding

5.2.3 Elliptic Labs

Website: <http://www.ellipticlabs.com/>

Technology name: Touchless gesturing with ultrasonic technology

Description: The device uses ultrasonic technology that recognizes gestures and allows for touchless interaction. Without touching the device, as the user's hand moves toward their smartphone for example, the screen lights up and information is displayed. As the hand moves closer, different information is revealed.

Status: Evolving

Funding Source/Mechanism:

5.2.4 Murata

Website: <http://www.murata.com/en-global/about/newsroom/news/product/timingdevice/2014/1117>

Technology name: Crystal unit

Description: Murata's high-tolerance small crystal units are optimal for wearable and data communications applications. With an overall frequency precision of +/-20ppm, these miniature crystal units can support the stringent frequency tolerances required for wireless communications such as LTE/3G, Wi-Fi, Bluetooth, Bluetooth Low Energy, ZigBee and NFC. They are also suitable for wired data communications applications such as Ethernet, USB3 in addition to hard disk, and solid-state disk computing systems.

Status: Available

Funding Source/Mechanism:

5.2.5 Mycestro

Website: <http://www.prnewswire.com/news-releases/mycestro-wearable-wireless-mouse-transforms-computing-experience-283032991.html>

Technology Name: Wearable wireless mouse

Description: This wearable, wireless 3D mouse worn on the finger delivers the same functionality as a traditional mouse with increased mobility. The Mycestro will work up to 30 feet from its dongle, plugged into the USB port of the device under control, and a full battery charge will last about 8 hours of normal use.

Status: Available

Funding Source/Mechanism: Crowdfunding



Photo source: <http://www.mycestro.com/>

6.0 Exoskeletons

6.1.1 Defense Advanced Research Projects Agency (DARPA): Airlegs

Website: <http://www.cbsnews.com/news/militarys-darpa-lab-creates-wearable-robot-to-help-soldiers-run-faster/>

Technology Name: Airlegs

Description: The power pack provides power to movement (like running) from a tank of compressed air connected by pulleys and electronic sensors to braces on the knees. The goal is to reduce the load by 25 percent, which developers said will allow the average soldier or Marine to run a mile in four minutes.

Status: Evolving

Funding Source/Mechanism: DARPA

6.1.2 Ekso

Website: <http://www.eksobionics.com/>

Technology name: Body suit

Description: This exoskeleton body suit powers steps when the wearer shifts his or her weight, then motors push the legs forward. The device is designed for people with traumatic injuries, including victims of strokes, spinal cord injuries or disease and brain injuries.

Status: Available - Ekso suits are available for use with certified trainers at centers around the country.

Funding Source/Mechanism:



Photo source:
<http://www.eksobionics.com/ekso>

6.1.3 Harvard Wyss Institute for Biologically Inspired Engineering: Soft Exosuit

Website: <http://wyss.harvard.edu/viewpage/456>

Technology name: Soft Exosuit

Description: The Soft Exosuit can be worn comfortably under clothing and could enable soldiers to walk longer distances, keep fatigue at bay, and minimize the risk of injury when carrying heavy loads. The lightweight Soft Exosuit is designed to overcome the challenges of traditional heavier exoskeleton systems, such as power-hungry battery packs and rigid components that can interfere with natural joint movement. It is made of soft, functional textiles woven together into a piece of smart clothing.

Status: Evolving



Photo source:
<http://wyss.harvard.edu/viewpressrelease/165/harvards-wyss-institute-awarded-darpa-contract-to-further-develop-soft-exosuit>

Funding Source/Mechanism: Awarded a first-phase \$2.9 million follow-on contract from DARPA to further develop a biologically inspired smart suit.

6.1.4 Purdue University

Website: <http://www.purdue.edu/newsroom/releases/2014/Q3/robotic-fabric-could-bring-active-clothing,-wearable-robots.html>

Technology name: Robotic fabric

Description: Robotic fabric moves and contracts and is embedded with sensors. The cotton material contains sensors made of a flexible polymer and threadlike strands of a shape-memory alloy that return to a coiled shape when heated, causing the fabric to move. According to the researchers, such an elastic technology could make possible robots that have sensory skin, stretchable robotic garments, suits pilots or astronauts to counteract the effects of acceleration, and lightweight, versatile robots to roam during space missions.

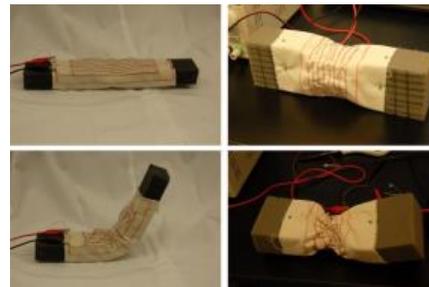


Photo source:
<https://news.uns.purdue.edu/images/2014/kramer-fabric.jpg>

Status: Evolving

Funding Source/Mechanism: NASA Early Career Faculty Award

6.1.5 StretchSense: I Measure U

Website: <http://www.stuff.co.nz/business/small-business/63627049/bionic-joints-could-become-a-reality>

Technology Name: Bionic limbs and sensors

Description: Researchers are exploring numerous commercial applications for bionic limbs (robotics attached to the outside of the body) including stroke rehabilitation, helping patients with compromised strength, and in manufacturing. StretchSense manufactures "rubber bands with Bluetooth" that measure body motion while attached to a limb. I Measure U is focused on the consumer market, manufacturing inertial measurement units that provide movement analysis for athletes.

Status: Evolving

Funding Source/Mechanism: Venture funding - StretchSense recently completed a \$500,000 seed funding round with the newly-formed Flying Kiwi Angels investors group and the New Zealand Venture Investment Fund.

6.1.6 Tokyo University of Science and Innophys Co.: Muscle Suit

Website: <http://blogs.wsj.com/japanrealtime/2014/11/12/wearable-power-assist-device-goes-on-sale-in-japan/>

Technology Name: Muscle Suit wearable power-assist device

Description: The Muscle Suit, which weighs 5.5 kilograms (12 pounds), can be worn “knapsack-style” and uses a mouthpiece as its control. It uses specially designed rubber tubes and compressed air as the source of its power. The Muscle Suit can help users pick up everyday loads with about a third of the usual effort.

Status: Soon to be released

Funding Source/Mechanism:



Photosource: http://innophys.jp/wordpress/wp-content/uploads/2014/10/2014_11_11_release_.pdf

7.0 Wearable Computers

7.1.1 Raytheon

Website: <http://investor.raytheon.com/phoenix.zhtml?c=84193&p=irol-newsArticle&ID=1977366>

Technology name: Wearable computer

Description: This device merges proven, wearable computer system with situational awareness capabilities to create an enhanced real-time view of the battlefield for commanders and their troops. Raytheon's innovative solution leverages investments already made in its deployed Air Warrior wearable computing technologies and couples that with the DCGS-A Lite capability that enables troops to receive intelligence and generate new intelligence as they perform missions in bandwidth-challenged areas.

Status: Evolving

Funding Source/Mechanism:

7.1.2 Tufts University

Website: http://www.eg.bucknell.edu/~emp017/papers/shibati_uist2014_posterDesign.pdf

Technology name: Passive physiological input

Description: The proposed interface uses passive physiological input as additional communication channels between wearable devices and wearers. This research utilizes three principles (Subscription, Accumulation and Interpretation) and introduces a core framework to enable continuous streams of input data, accumulate the data in a buffer, and attempt to recognize patterns in the accumulated data upon request from the application, rather than directly in response to the input events.

Status: Evolving

Funding Source/Mechanism: National Science Foundation and Google supported this research.

7.1.3 University of Canterbury

Website: <http://www.scoop.co.nz/stories/ED1411/S00013/two-uc-experts-receive-870000-of-funding.htm>

Technology Name: Wearable computer interface design

Description: Researchers are exploring how models of human cognition can be adapted for wearable computer interface design, particularly how to use models of human attention to create wearable interfaces that do not distract the user. The team aims to use cognitive psychology techniques to model the user and the wearable computer as a single system. This model can then be used to reduce the demand on the brain's working memory while the user performs activities such as walking while searching through icons on the display. The overall outcome will be wearable applications that can be used without distracting the user from real-world tasks.

Status: Evolving

Funding Source/Mechanism: Received \$870,000 of Marsden funding over three years.

8.0 General

8.1.1 Actuate: BIRT iHub and Analytics

Website: <http://www.theinquirer.net/inquirer/news/2382737/actuate-brings-wearables-to-big-data-with-android-wear-integration>

Technology Name: BIRT iHub 3.1 and BIRT Analytics 5.0

Description: The applications help users turn wearable-generated data into usable information. The BIRT Analytics backend allows customers to set up a system-as-a-server to analyze data and offer it up to an open API. The BIRT iHub optional frontend turns that data into information with value-added visual representations in the form of charts and spreadsheets viewable across desktop, tablet, mobile, and wearable devices.

Status: Soon to be released

Funding Source/Mechanism:

8.1.2 Allied Minds: Seamless Devices, Inc.

Website: <http://www.alliedminds.com/announcements/allied-minds-announces-the-formation-of-seamless-devices-inc>

Technology Name: Seamless Devices analog signal processing

Description: Seamless Devices is developing applications for analog signal processing to produce high-performance signals even as transistors are scaled down in size. The company expects to be able to offer analog-to-digital converters for telecom applications, to address the demand for analog-to-digital converters that can operate at high bandwidth and high resolution with low power consumption.

Status: Evolving

Funding Source/Mechanism:

8.1.3 Alpinestar: Tech-Air

Website: <http://www.dailymail.co.uk/sciencetech/article-2824021/The-wearable-AIRBAG-Motorecyclist-s-jacket-fitted-bladders-expands-impact-soften-blow.html>

Technology Name: Tech-Air street system – garments fitted with airbags

Description: Alpinestars' Tech-Air street system is essentially a portable lining for bike jackets. When the system detects an impact, a built-in canister and 'bladder' inflates to protect the



Photo source: <http://www.alpinestars.com/tech-air>

wearer's body. Sensors inside the Airbag Control unit monitor the impact, and the whole system is powered by a lithium-ion battery.

Status: Soon to be released

Funding Source/Mechanism:

8.1.4 Arco: Smart Reactor

Website: <http://neworksco.com/arco.html>

Technology name: Smart Reactor

Description: The Smart Reactor uses white and RGB LEDs to handle different types of notifications. It connects to your phone using Bluetooth to receive notifications from your phone – including e-mail messages, calendar events, incoming calls, and social media updates.

Status: Evolving

Funding Source/Mechanism: Crowdfunding

8.1.5 ARM Holdings: MBED OS

Website: <https://mbed.org/>

Technology name: MBED OS

Description: The operating system designed of IoT devices is designed to resolve productivity problems associated with running a mix of devices using different protocols. ARM aims consolidate devices into a single software layer.

Status: Soon to be released - 2015

Funding Source/Mechanism:

8.1.6 Betatrac: eBodyGuard

Website: <http://www.betatrac.com/products/aimss-geo-visual/ebodyguard/>

Technology name: eBodyGuard

Description: The eBodyGuard interactive composite jacket equipped with GSM/GPRS/GPS and a miniature camera. The jacket comfortably holds all the technology while hiding the cables connecting everything to the battery and modem. The device combines hardware (eGuard, eGuard-K9 and eBodyGuard) and software called AIMSS (Analytical Intelligent Mobile Security Systems) with communications technologies, and controls it all from a central management console. The technology can track people and assets in real time and monitor voltage, speed, movement, temperature and location – which is overlaid on a map.

Status:

Funding Source/Mechanism:

8.1.7 Body Biolytics

Website: <http://bodybiolytics.com/>

<http://www.zdnet.com/article/wearables-solution-startup-prototypes-predictive-analytics/>

Technology name: Predictive analytics software

Description: Body Biolytics provides Activity Recognition Engines that are easily used by data aggregators and application developers to bring useful machine learning technology and AI features into their software or app.

Status: Evolving

Funding Source/Mechanism:

8.1.8 Clone: Algo

Website: http://articles.economictimes.indiatimes.com/2014-11-07/news/55871749_1_wearable-devices-artificial-intelligence-technology

Technology Name: Artificial intelligence chip-embedded clothing

Description: Niraj Goel's group of companies under Clone Algo is designing wearable devices that will use artificial intelligence in chip-embedded clothes to reduce the usage of hand-held tools. The designer is set to create wearable devices with chips embedded into body wears such as clothing, belts, shoes, and rings, among others.

Status: Evolving

Funding Source/Mechanism: Internal - Clone Algo is raising \$ 250 million by selling 20 million shares at \$ 12.50 per piece through a share placement which would value the tech company at \$11 billion.

8.1.9 DOCTO

Website: <http://www.pr.com/press-release/593815>

Technology Name: DOCTO

Description: The DOCTO app complements medical sensors and fitness wearables by applying biometric analysis to provide diagnostics to the user. The app recognizes particular combinations of high and low readings that indicate a significant health development. The device integrates multiple biometrics from various devices such as glucose, heart rate, and blood pressure monitors. The technology may be

applicable to wearables like smart fabrics and sweat analyzers. DOCTO can monitor vitals and inform at-risk individuals of irregularities in their general well-being.

Status: Evolving

Funding Source/Mechanism: Crowdfunding

8.1.10 Ducere Technologies: Lechal

Website: <http://lechal.com/>

Technology name: Lechal Bluetooth-enabled haptic shoe

Description: The Lechal shoe uses haptic technology and digital mapping to signal the wearer through vibrations, the intensity and duration of which vary to correlate with the distance to an upcoming turn. The insoles are embedded with removable sensors powered by two rechargeable lithium polymer batteries which sync with mobile apps like Google maps. Directions are relayed through haptic feedback through vibrations either in the left or the right shoe.

Status: Soon to be released

Funding Source/Mechanism: Cofounders raised more than \$2 million seed capital, have over 40,000 online preorders (\$6 million).

8.1.11 Eidos

Website: <http://www.timbouckley.com/eidos.html>

Technology name: Eidos Vision and Audio

Description: Eidos products allow users to have better control over their senses. The visual device overlays what the user is seeing with images recorded just a few milliseconds ago. The effect is similar to time-lapse video, only in real time. The user can see moving objects more clearly and determine patterns in them. The audio device allows users to isolate sounds, screening out background noise similar to Soundhawk.



Photo source: <http://www.timbouckley.com/eidos.html>

Status: Evolving

Funding Source/Mechanism:

8.1.12 FacialNetwork Inc.: Orbit

Website: <http://www.nametag.ws/>

Technology name: Orbit cloud-based facial recognition

Description: Orbit is a cloud-based facial recognition app designed for facial recognition authentication on mobile devices, facial recognition for smartphones and facial recognition applications for Google Glass

Status: Evolving

Funding Source/Mechanism:

8.1.13 Google

Website: <http://googleblog.blogspot.com/2014/01/introducing-our-smart-contact-lens.html>

Technology name: Smart contact lenses

Description: These specially designed contact lenses are fitted with wireless chips and glucose sensors that are able to measure blood sugar levels in a diabetic's tears.

Status: Evolving

Funding Source/Mechanism:

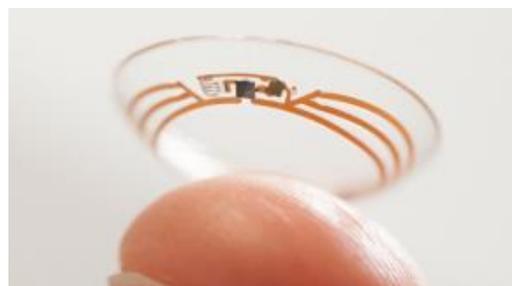


Photo source: <http://googleblog.blogspot.com/2014/01/introducing-our-smart-contact-lens.html>

8.1.14 Imagination

Website: <http://www.pcworld.com/article/2845432/wearable-graphics-could-get-a-boost-with-imaginations-series7-gpus.html>

Technology Name: PowerVR Series7 graphics processor unit

Description: Imagination's power-efficient PowerVR Series7XE and Series7XT graphics processors are targeted at wearables, mobile devices, gaming consoles, PCs, and servers and could be used for image recognition and object detection in smartglasses and headsets.

Status: Soon to be released

Funding Source/Mechanism:

8.1.15 Ineda Systems

Website: <http://www.inedasystems.com/>

<http://www.businesswire.com/news/home/20141111005359/en/Ineda-Systems-Secures-Additional-Series-Funding#.VL7zw00cRMw>

Technology Name: Low-power system-on-chip

Description: Ineda's architecture is optimized for long battery life and scalable performance required to run applications in the wearable and IoT space.

Status: Evolving

Funding Source/Mechanism: Venture funding - \$19 million in Series B funding. Investors include Cisco, Samsung Catalyst Fund, Qualcomm Ventures, and Imagination Technologies.

8.1.16 Institute of Textiles and Clothing

Website: <http://www.polyu.edu.hk/cpa/excel/en/201410/research/r1/index.html>

Technology name: Fabric circuit board

Description: This fabric circuit board (FCB) is made of pre-stretched elastic yarn and polyurethane-coated copper fibers. With novel computerized textile technology, the FCBs are made by knitting a combination of conductive and conventional fibers. The textile with knit-in electrical wiring that can be worn, washed, folded and even shot through with bullets. This research provides the example that the fabric can be built into a soldier's bulletproof Kevlar vest; if the wearer is shot, the material can sense the bullet's impact and send radio a message back to a base.



Photo source: <http://www.polyu.edu.hk/cpa/excel/en/201410/research/r1/index.html>

Status: Evolving

Funding Source/Mechanism:

8.1.17 Invensense®: MotionTracking™

Website: <http://www.invensense.com/mems/gyro/catalog.html>

Technology name: Single-chip MotionTracking™

Description: System-on-chip solutions are developments in microelectronics that have enabled researchers to create miniature circuits that combine sensing, front-end amplification, MCU functions, and RF transmission. Wearable sensors have applications in monitoring biochemical sensors monitor chemical compounds in the atmosphere or people working in hazardous environments. InvenSense® single-chip MotionTracking™ solutions combine micro-electromechanical system, or MEMS, based motion sensors, such as accelerometers and gyroscopes, with mixed-signal integrated circuits to improve performance, accuracy, and intuitive motion- and gesture-based interfaces.

Status: Available

Funding Source/Mechanism:

8.1.18 iStrategyLabs: Dorothy

Website: <http://istrategylabs.com/>

Technology name: Dorothy

Description: Dorothy is powered by the LightBlue Bean, an Arduino micro-controller with a built-in Bluetooth chip, accelerometer, and coin cell battery. Dorothy’s “ruby” sensor is placed inside a shoe and when tapped three times it sends a fake call to the user and can also send custom texts to contacts, notifying them of the user’s location.

Status: Evolving

Funding Source/Mechanism:

8.1.19 Karen Janssen: HERE for Gear

Website: <http://360.here.com/2014/11/07/wearable-maps-making-glance-navigation-smartwatches/>

Technology Name: HERE for Gear navigation app

Description: The navigation app offers turn-by-turn pedestrian navigation and public transit routing fit for display on smaller screens or smartwatches.

Status: Available

Funding Source/Mechanism:

8.1.20 Korean Agency for Technology

Website: <http://koreabizwire.com/korea-likely-to-be-a-leader-in-wearable-device-standards/24080>

Technology Name: Standards

Description: The Korean Agency for Technology and Standards suggested the establishment of a standard-setting committee for wearable smart devices. The agency suggested a total of 18 international standards in the areas of semiconductor (9 standards), display (5), and electronic printing (4).

Status:

Funding Source/Mechanism:

8.1.21 Lineable

Website: <http://www.lineable.net/>

Technology name: Lineable wearable beacon

Description: The Lineable tracking bracelet syncs with users' smartphones through Beacon and Bluetooth 4.0 technology. Parents or guardians can use mobile devices to track their children in a given area.

Status: Soon to be released - February 2015.

Funding Source/Mechanism: Crowdfunding

8.1.22 MEU

Website: <http://www.themeu.net/hardware/meu-square/>

Technology name: MEU square wearable LED display

Description: The MeU Square, a full-color LED matrix display with a microcontroller and a Bluetooth radio, allows wireless communication with other devices. The product allows users to display any text, image, or pattern.

Status: Evolving

Funding Source/Mechanism: Crowdfunding



Photo source:
<http://www.themeu.net/applications-2/biking/>

8.1.23 Microsoft

Website: <http://www.wearable.com/wearable-tech/microsoft-bone-conduction-headset-for-the-blind-448>

Technology Name: Bone-conduction headset

Description: This bone-conducting headset could help guide blind and visually impaired people. Users wearing the headset receive audio guidance without having their ears covered. Bone conduction delivers sound to the inner ear, using the skull as a delivery method. Bone conduction transmission works with people with regular or impaired hearing.

Status: Evolving



Photo source: <http://www.wearable.com/wearable-tech/microsoft-bone-conduction-headset-for-the-blind-448>

Funding Source/Mechanism:

8.1.24 Myo-systems: PurePhones

Website: <http://www.thenewadhd.com/>

Technology name: PurePhones

Description: Pure Phones helps users optimize their cognitive abilities. The device uses sound to “trick” the brain into hearing something that is not actually there by intentionally calibrating your brainwaves to a situation. This “phantom noise” causes the brain to elevate its operating speed to maintain homeostasis.

Status: Evolving

Funding Source/Mechanism: Pursuing their first major round of funding

8.1.25 Nanyang Technological University

Website: <http://techassimilate.com/2014/11/flexible-wearable-electronic-circuits-printed-using-a-t-shirt-printer/>

Technology Name: Flexible wearable electronic circuits via T-shirt printer

Description: Using the T-shirt printing equipment, scientists successfully printed transistors, capacitors, and resistors onto materials such as paper, fabric, plastic, and aluminum foil. Instead of ink the printer used printing materials containing silver nanoparticles, non/conductive plastics, and carbon. This included printing 4bit D/A (digital to analogue converters) and RFID tags onto wearable component materials.

Status: Evolving

Funding Source/Mechanism:

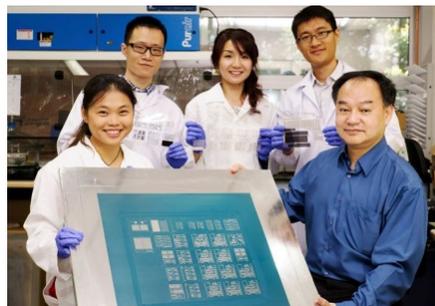


Photo source: <http://techassimilate.com/2014/11/flexible-wearable-electronic-circuits-printed-using-a-t-shirt-printer/>

8.1.26 National Physical Laboratory

Website: <http://www.npl.co.uk/science-technology/electronics-interconnection/technical-areas/smart-textiles>

Technology name: Smart textiles

Description: The National Physical Laboratory (NPL) developed a technique to produce conductive textiles that may make integrating electronics into clothing simple and practical by enabling lightweight circuits to be printed directly onto complete garments. This could have applications in the sports, health, medicine, consumer electronics and fashion industries.

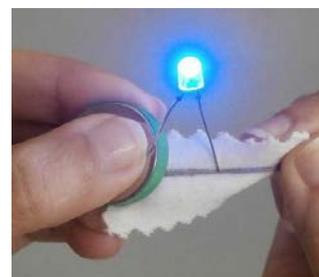


Photo source: <http://www.npl.co.uk/science-technology/electronics-interconnection/technical-areas/smart-textiles>

Status: Evolving

Funding Source/Mechanism: NPL won a Knowledge Transfer Partnership award from Innovate UK and will be partnering with Coventry University to work in the area of smart textiles.

8.1.27 Ohio State University

Website: <https://electroscience.osu.edu/research-publications/textile-and-wearable-antennas>

Technology name: Textile wearable antenna

Description: In this research project, textile antennas are made from embroidered conductive fibers, referred to as E-fibers, that offer high surface conductivity (nearly equivalent to copper), are flexible and mechanically strong, and can be integrated into garments. According to researchers, the technology offers improved mechanical and radiofrequency performance compared to traditional rigid antennas and circuits and may have a range of applications including body-worn communications.



Photo source: <https://u.osu.edu/kiourti.1/research/>

Status: Evolving

Funding Source/Mechanism:

8.1.28 OriginGPS: NanoSpider

Website: <http://www.origingps.com/>

Technology Name: Nano Spider

Description: Nano Spider is a GPS module (4x4x2.1mm in size) designed for use in small smart devices. The Nano Spider tracks GPS satellites to provide real-time positioning data. The company's Noise Free Zone system gives the device a strong signal even in urban canyons, under dense foliage, or a rapidly-changing receiver position.

Status: Evolving

Funding Source/Mechanism:

8.1.29 Ramco

Website: <http://www.thehindubusinessline.com/features/smartbuy/tech-news/ramco-offers-erp-for-wearables/article6571416.ece>

Technology Name: Enterprise resource planning (business management) software

Description: The enterprise resource planning business management software provider is adapting its system for use with wearable devices. The applications will add value for businesses that depend on a continuous flow of information, including aviation, particularly in maintenance, e-commerce, and health care.

Status:

Funding Source/Mechanism:

8.1.30 Re-Timer

Website: <http://www.virgin.com/travel/wearable-technology-that-combats-jetlag>

Technology Name: Re-Timer glasses to combat jetlag

Description: The Re-Timer glasses shine UV-free green light into the user's eyes to help adjust circadian rhythms, which is proposed to reduce the effects of jetlag. Wearing Re-Timer sleep glasses for 30–50 minutes a day is suggested to provide the bright light necessary for a user to maintain a healthy sleep–wake rhythm.

Status: Available

Funding Source/Mechanism:



Photo source: <http://re-timer.com/>

8.1.31 Soundhawk

Website: <http://www.soundhawk.com/>

Technology name: Soundhawk

Description: Soundhawk is a hearing device that cuts through background noise, focusing on the speech of the person the user wants to hear. An app lets the user tune the device to listen for specific sounds to make louder while reducing other sounds.

Status:

Funding Source/Mechanism:



Photo source:
<http://www.soundhawk.com/product>

8.1.32 Tech Museum of Innovation: Body Metrics Exhibit

Website: <http://www.bizjournals.com/sanjose/news/2014/11/26/new-tech-museum-interactive-exhibit-educates.html?page=all>

Technology Name: Integrated full-body kit

Description: The Body Metrics Exhibit provides users with off-the-shelf hardware and custom software to measure social, physical, and emotional aspects of museum visitors in real-time. Visitors' full-body kit

includes a Somaxis Cricket shoulder sensor that picks up muscle tension and heart rate, the MindWave Mobile NeuroSky electrocardiogram headset receiver for measuring brain activity, and a custom iPod touch that gathers motion data and takes pictures. The technology transmits the data to an on-site server where it is analyzed using custom software by Local Projects.

Status: Available

Funding Source/Mechanism:

8.1.33 Toshiba: AppLite™

Website: <http://www.businesswire.com/news/home/20141110005363/en/Toshiba-Expands-Lineup-Application-Processors-Wearable-Devices#.VIXnqE0cRmM>

Technology Name: TZ1021MBG App Lite™ application processor for wearable devices

Description: TZ1021MBG integrates a low-power consumption processor and Flash memory, without the Bluetooth Low Energy and accelerometer that Toshiba integrated into the previous “TZ1001MBG”. The processor integrates highly sensitive analog-to-digital converters well-suited for measuring weak biomedical signals such as the pulse and the heart’s electrical activity (like an electro-cardiogram).

Status: Soon to be released

Funding Source/Mechanism:

8.1.34 Tsinghua University: iGaze

Website:
<http://www.newscientist.com/article/mg22329874.600-gazetracker-lets-you-connect-to-devices-with-a-glance.html>

Technology name: iGaze headset

Description: This wearable, head-mounted computer tracks the user’s gaze using an eye-tracking camera that calculates where the wearer is looking and transmits it to all the nearby internet-connected devices, such as stereos and TVs, via Wi-Fi. The devices reply with a beep played through the headset and the wearer nods to confirm a desire to connect.

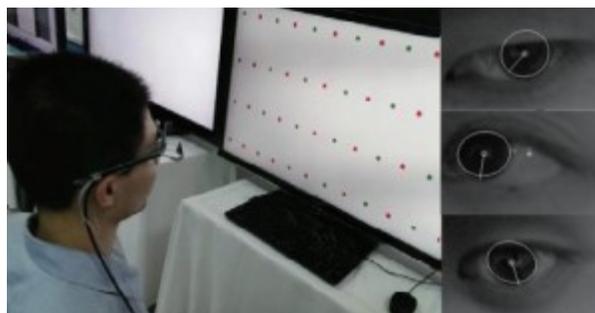


Photo source: <http://www.cs.iit.edu/~xli/paper/Conf/iGaze-mobi14.pdf>

Status: Evolving

Funding Source/Mechanism

8.1.35 University of Adelaide

Website: <http://phys.org/news/2014-11-wearable-antennas-remote.html>

Technology Name: Wearable antenna

Description: The antennas can be incorporated into clothing using computerized embroidery into conductive fabric. The wearable antennas have potential application in biomedical monitoring, sports analysis, military and emergency communications. The solution being developed is a t-shirt made of conductive metallized fabric that is low-cost, flexible, and lightweight. It is reported to not deteriorate easily and is washable, with the antenna embroidered onto the textile.

Status: Evolving

Funding Source/Mechanism:

8.1.36 University of California: Hush

Website: <http://mashable.com/2014/11/29/smart-earplugs/>

Technology Name: Hush smart earplugs

Description: The smart earplugs use noise-masking to block outside sounds while working in conjunction with a smartphone via an associated app, allowing users to receive alerts from their mobile device. Sound-eliminating foam, combined with noise-masking sounds (including white, pink, and brown noise, ocean waves, a waterfall and even raindrops) emitted by the in-ear plug (at up to 30 to 40 decibels) for up to 10 hours, results in what the creators claim is a noise reduction of up to 70 decibels.

Status: Soon to be released

Funding Source/Mechanism: Crowdfunding

8.1.37 University of Texas

Website: [10.1109/DCAS.2014.6965331](https://doi.org/10.1109/DCAS.2014.6965331)

Technology Name: Memory nap controller

Description: Researchers propose a technique that reduces the static power consumption in caches with no side effect on processor performance. The proposed architecture achieves this power saving by deterministically lowering the power state of cache lines that are guaranteed not to be accessed in immediate future cycles. Simulation of the architecture across different cache configurations, using widely known CAD tools, demonstrated up to 92% reduction in static power consumption on SPEC2006 benchmarks with no performance penalties and minimal hardware overhead.

Status: Evolving

Funding Source/Mechanism:

8.1.38 University of Tokyo

Website: <http://healthtechinsider.com/2014/11/25/idtechex-ultraflexible-devices-wearable-electronics/>

Technology Name: Ultraflexible circuits

Description: Researchers are creating printed circuitry on thin (1-micron thick), flexible plastic substrates. According to the researchers, the low-power components and thin film batteries or energy harvesting power could lead to sensors that are as easy to apply and that communicate wirelessly to a controller for processing and forwarding.

Status: Evolving

Funding Source/Mechanism:

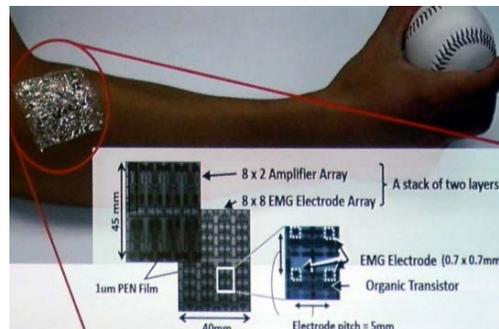


Photo source: <http://www.idtechex.com/events/presentations/ultraflexible-devices-and-electrodes-for-wearable-electronics-and-beyond-005381.asp>

8.1.39 Viametrica and SensorUp

Website: <http://venturebeat.com/2014/09/16/vivametrica-launches-health-data-aggregation-platform-for-fitness-trackers-apple-watch-google-fit/>

Technology name: Industry Standards

Description: The exponential growth in the number of people tracking their health through activity monitors and biosensor devices is driving the need for industry standards. Vivametrica and SensorUp have formed a partnership to collect, standardize, and integrate data from wearable devices for application in healthcare environments.

Status: Evolving

Funding Source/Mechanism:

8.1.40 Visual Intelligence: iOne

Website: <http://www.visualintelligenceinc.com/visual-intelligence-awarded-additional-patent-for-array-based-imaging-technology-with-groundbreaking-uses-in-smart-phones-uavs-automobiles-and-more/>

Technology name: iOne sensor technology

Description: Miniaturized imaging technology that provides ultra-high resolution and multi-sensor functionality may allow for powerful multi-function imaging system with features such as infrared, night vision, ultra-high resolution, engineering-grade metric imaging, image fusion—all through a very small aperture and with a form factor that uses very little real estate in the device.

Status: Evolving - Visual Intelligence was granted the patent and is initiated a licensing program for manufacturers seeking miniature imaging technology.

Funding Source/Mechanism:

8.1.41 Wearable Experiments: Navigate

Website: http://www.dailymail.co.uk/travel/travel_news/article-2825027/Navigate-GPS-jacket-guides-tourists-cities-vibrating-sleeves.html

Technology Name: Navigate GPS jacket

Description: The jacket directs the wearer with subtle vibrations, indicating when they need to turn right to get to their desired destination. The hardware is embedded in the jacket, and once synced with the Navigate App, and the destination is entered in, it will guide you through to your final destination.

Status:

Funding Source/Mechanism:

8.1.42 Zikto: Arki

Website: <http://www.planetbiometrics.com/article-details/i/2442/>

Technology Name: Arki wristband

Description: The wearable device aims to improve users' walking posture also features biometric qualities, with people's "unique" walking patterns used to authenticate their identity. The device measures a user's walking pattern so that it can become a password.



Photo source: <http://www.zikto.com/>

Status: Evolving

Funding Source/Mechanism: Crowdfunding

Appendix A

Technology Summary

Appendix A

Technology Summary

The following spreadsheet provides a summary of the technologies compiled in this report. For an electronic copy, please contact Jaki Upton at jaki.upton@pnnl.gov. *This information is not meant to be an exhaustive list nor an endorsement of any technology described herein.*

Company	Technology	Description	Status
Sensor			
Physiological			
3L Labs	Footlogger	Bluetooth-connected shoe insole activity tracker	Soon to be released
Adidas	MiCoach	Smart fabric measure heart rate	Available
Athos	Core exercise shirts and shorts with built in sensors	The Core sensor contains the electronics and intelligence to collect and interpret your biosignals, such as muscle effort and fatigue, heart rate and variability, breathing patterns, etc.	Soon to be released
BabyBe	BabyBe	Bionic mattress that brings haptic information from the mother (like her breathing and heartbeat) to the baby.	Evolving
BabyGuard	BabyGuard	Sensor units embedded in clothing to monitor babies vital data.	Evolving
Backtrack	Backtrack	Bendable sensor worn near the spine to track data points like pressure and angle of movement.	Evolving
Bar-Ilan University	Glucose tester wristband	Wearable biometric system that utilizes lasers and a magnet to directly monitor glucose levels in the blood stream and dehydration.	Evolving
Bebop	Wearable Smart Fabric Sensor	Smart fabric sensor for real-time monitoring on force, x/y location, bend, twist, size, stretch and motion	Available
BioSensive Technologies	Ear-o-Smart	Earring that uses photoplethymogram (PPG) technology to measure blood flow to monitor the user's heart rate, activity level, and number of calories burnt.	Evolving
BITalino	BITalino	Monitors and responds to human biosignals.	Available
BSXinsight	Wearable Lactate Threshold Sensor	BSXinsight is a compression sleeve worn on the calf that is able to analyze changes in your exercising muscle to immediately identify lactate threshold.	Available
Catapult Sports	Sporting Wearables	Measures more than 100 fields of data, including heart rate, distance, velocity, acceleration and deceleration, speed, and shock to monitor wearer movement and fatigue.	Soon to be released
CharmCare	H2 wearable blood pressure monitor	Small, lightweight wearable blood pressure monitor.	Evolving
Chinese PLA, General Hospital	Wearable healthcare monitoring systems (WHMS) with GALL and Kalman filters	Use of an adaptive filter to reduce motion artefact (MA) in physiological signals acquired by WHMSs.	Evolving
Code4Armour	Alert wristband	Delivers vital personal health information to first responders in seconds in the event of an emergency.	Soon to be released

Company	Technology	Description	Status
Electrozyme	Electrozyme	Wristband with a biosensor strip that analyzes chemical composition of user's sweat and sends notifications.	Evolving
embr Labs	Wristify	The wristband harnesses thermoelectrics to both heat and cool a patch of skin and is capable of changing that surface at a rate of 0.4 degrees Celsius per second.	Evolving
Empatica	Embrace wristbands	Medical-quality wearables to help measure stress, epileptic seizures, activity, and sleep through electrodermal activity.	Evolving
Evoke Neuroscience	Brain activity, heart rate and rate variability sensors	The sensors gather data via a set of high-end headphones and an arm band to increase biofeedback control over biometrics.	Soon to be released
FitLinxx	AmpStrip wearable heart and activity monitor	Continuously wearable activity monitor for heart rate, activity, respiration, body temperature, and posture.	Soon to be released
Force Impact Technologies	FITGuard mouthpiece	Mouthguard equipped with LED and sensors to monitor the center of gravity of the brain and detect potential head injuries.	Evolving
FuelWear	Flame Base Layer	An embedded sensor in the wearable technology registers the body's heat in order to continually adjust.	Soon to be released
Healthwatch	hWear™ smart textile garment	Digital, heart-sensing garment incorporating interwoven textile for detecting ECG signals.	Evolving
Hexoskin	Biometric Smart Tee	The shirt is equipped with sensors capable of tracking over 3,000 data points every minute. The technology monitors heart rate, breathing rate, activity, and sleep.	Available
Imperial College of London	AcuPebble	Detects sounds emanating from the heart and respiratory system to indicate deteriorating health or illness.	Evolving
Institute of Biomedical Engineering	Wearable brain monitoring - mobile electroencephalogram (EEG)	This around-the-ear device allows for continuous and reliable monitoring of brain activity and has the additional possibility to record vital signs.	Evolving
Intel and Anouk Wripprecht	Synapse Dress	Sensor tracks attention level and focus fluctuations and sensor monitors proximity; includes camera.	Evolving
Khalifa University of Science, Technology, & Research	Wearable pressure sensor	Wearable pressure sensor made of carbon cottons with moderate electrical conductivity.	Evolving
Lifebeam	Lifebeam hat and helmet	Bluetooth®- and ANT+™-equipped hat uses electro-optical sensors to monitor heart rate, cadence, and calories.	Available
MC10	Biostamp flexible sensor	Patch with sensors that monitor temperature, movement, heart rate and more, and transmit this data wirelessly back to patients and their clinicians.	Evolving

Company	Technology	Description	Status
Medtronic	Seeg Mobile Cardiac Telemetry (MCT)	Adhesive, water-resistant, wireless wearable cardiac sensor.	Available
Moodmetric	Moodmetric Smart ring	Small, wearable ring with biometric skin conductance sensors that provides feedback through a Bluetooth connection to a smartphone.	Evolving
Myontec	Mbody Coach	Textile sensors to collect EMG signals to tell how hard the wearer is working.	Evolving
Netatmo	Wrist device	Records UV exposure and alerts the user if exposure is too great.	Available
NewDealDesign	Project Underskin	Sub-dermal tattoo that will run off of the body's electro-chemical energy and will have the ability to monitor blood sugar, exchange information through a simple handshake, unlock front doors, etc.	Evolving
Northwestern University, University of Illinois at Urbana-Champaign	Wearable skin monitor	This wearable health monitor can track skin and heart conditions while being worn discretely on the skin.	Evolving
Olive	Olive bracelet	Manage stress by monitoring a user's heart rate, ambient light, and skin temperature.	Soon to be released
Qardio, Inc.	Qardiocore wearable ECG monitor	Wearable ECG monitor that collects biometric data and transmits to patients and physicians.	Available
Rijuven	Rejiva	Wireless ECG-based patch that captures overall health, manages stress, appraises the aging process, and tracks sleep and energy level.	Soon to be released
Sensogram	SensoTRACK	Ear-worn fitness device that can simultaneously measure and monitor heart rate, respiration rate, oxygen saturation, and blood pressure in real time, along with a range of other parameters.	Soon to be released
Sensoria	Textile Sensors	Textile sensors embedded in the fabric of these garments give information on heart rate, activity, running form, wellness, and fitness levels.	Available
Smartcadia	Inner You (INYU)	Handheld sensor that monitors breathing, skin conductance, and physical activity.	Evolving
Spire	Spire wearable health tracker	Tracker measures breathing patterns to make users aware of their focus, tension, and calm levels.	Available
Spree	Smartcap	Measures heart rate, temperature, movement, and calories burned	Available
Thync	Thync Vibes neurosignaling wearable device	The device is intended to use neurosignaling to shift a person's state of mind.	Soon to be released
University of Buffalo, Sentient Science	Wearable technology	Wearable technology that fuses real-time medical and physiological data with computer models.	Evolving
University of Cincinnati	Sweat sensor skin patch	A patch to measure biomarkers in sweat, sodium sensor, voltage meter, communication antenna, microfluidics, and controller chip	Evolving

Company	Technology	Description	Status
University of Memphis	Kinematic-based activity recognition systems	Wearable sensors that use kinematic-based activity recognition systems to identify sedentary and light-intensity activities.	Evolving
V1bes	V1bes activity monitor ring	V1bes looks at stress both in the body and from the environment. To detect, it looks at brainwaves, heart rate, and molecular stress from surrounding electromagnetic pollution.	Evolving
Valencell	PerformTek sensor technology	Biometric sensors that continuously measure heart rate and activity and physiological data	Available
Welch Allyn and Gentag	Skin patches	Lightweight, flexible patches for glucose monitoring, diagnostics, drug delivery, and geolocation.	
Zoll	Zoll LifeVest	Wearable defibrillator	Available
Particle			
Borre Akkersdijk and Martijin ten Bhomer	BB.Suit 2.0	The material has an “integrated air quality sensor” that can analyze air pollution.	Evolving
Chemisense	Chemical sensor	Chemical sensor that can detect chemicals present in the air around you in real time.	Evolving
Frog Shanghai	AirWaves pollution mask	A pollution mask that filters air pollution and monitors the air quality.	Evolving
HabitatMaps	AirBeam wearable air monitor	AirBeam uses a light-scattering method to measure particle matter 2.5.	Evolving
Morphix Technologies	Chameleon	The wearable device allows hands-free detection of up to 10 different hazards at one time in a variety of operating environments.	Available
Nanozen	Wearable particle sensor	The monitor can detect particles as small as one micron and even less.	Soon to be released
NTT Docomo	Docotch	Measure air quality in the home. The device is equipped with humidity and temperature sensors.	Soon to be released
TZOA	TZOA Enviro-Tracker	Measures air pollution (particle matter) and UV exposure.	Evolving
UC Berkeley	Clarity wearable air quality monitor	Wearable air quality monitor that measures air pollutants including particulate matter 2.5, volatile organic compounds, nitrogen dioxide, and ammonia.	Evolving
WindSix	Intelligent Wearable Air Purifier	The headset's powerful, high-precision filter purifies the air around it by up to 99.9 percent and uses non-ozone electrostatic dust removal technology.	Evolving
Other			
Bionym	Nymi	Recognizes your individual heart rhythm and automatically unlocks a device.	Soon to be released
Captiks	Movit – miniature unit for motion capture	Measure body motions for kinematic and functional analysis.	Evolving

Company	Technology	Description	Status
Sail Research	Pathfinder	Translates sight into touch, allowing blind and visually impaired users to rapidly scan and identify any environment.	Evolving
Samsung	Simband modular smartband	Smartwatch and a wristband connector that holds custom sensor modules.	Available
Displays			
Heads-up			
Ashkelon	Ashkelon Visor	Touching the Smartphone, as well as other kinds of movements, controls the menu selection process. A free application will adapt the various functions of the Smart Phone so they can appear in the Focusing Relay.	Evolving
Atheer Labs	Augmented reality glasses	A sensor built into the pair of glasses can pick up the shape of your hands and whether you're swiping left or right, or clicking on an augmented reality button.	Soon to be released
DAQRI	Smart helmet	Helmet outfitted with augmented reality and 4D interface to allow users to see content and touch/control using third party devices like a smartwatch.	Soon to be released
Elbit Systems	Skylens wearable heads-up display	The Skylens wearable heads-up display was designed for commercial pilots to give a better view of proceedings, through augmented vision that can help them navigate through fog and darkness and improves situational awareness.	Evolving
Fusar Technologies	Guardian GA-1 augmented reality motorcycle helmet	DOT-approved, Android-based augmented reality motorcycle helmet with heads-up display.	Evolving
Google	Google Glass with customized software	Google Glass will be able to use facial recognition to match suspects to any existing profiles based on their face print.	Soon to be released
i2i	iPAL glasses	iPal uses your eye gestures as a control mechanism, allowing a hands-free, attention-free experience.	Evolving
Magic Leap	Dynamic Digitized Lightfield Signal™	Magic Leap's augmented-reality technology is alleged to generate images indistinguishable from real objects and then being able to place those images seamlessly into the real world.	Evolving
Mitsumi	Laser eyewear	These wearable glasses deliver a wide viewing angle, a high level of brightness, and decent color reproducibility.	Evolving
NUVIZ	NUVIZ	NUVIZ provides navigation, weather, telemetry, and other useful information and allows the user to capture photos, stay connected on the road, and listen to music.	Evolving

Company	Technology	Description	Status
Optinvent	Ora	Features a front-facing, 1080p, 5MP camera; a 9-axis motion sensor; wireless connectivity with Bluetooth; Wi-Fi; and GPS as well as a trackpad for tactile interactions.	Soon to be released
Recon Instruments	Snow2 heads-up display	Goggles that provide a display of detailed information including: speed, jump analytics, altitude, map, compass, messaging capabilities, and markers showing the location of others on the slopes.	Available
SAP and Vuzix	Video eyewear	Improve the user experience and work processes by offering a hands-free working experience. The wearer interacts with the device using voice commands.	
Skully	Skully augmented reality motorcycle helmet	Motorcycle helmet fitted with augmented reality technology to provide wide-angle rearview camera and transparent heads-up display.	Soon to be released
Sony	SmartEyeglass	SmartEyeglass is equipped with a range of different sensors, such as an electronic compass, a gyroscope, an accelerometer, an ambient light sensor, and a 3 megapixel camera.	Soon to be released
TrackingPoint	ShotGlass	Features a high-definition video display, an HD camera that can record audio and video, and optical controls that allow the user to control the glasses even when wearing thick gloves.	Soon to be released
University of Fukui	Laser beam combiner	This technology could offer immediate, hands-free access to information via gadgets such as smart glasses, which overlay computer-generated visual data on the user's field of vision.	Evolving
Body-worn			
Arubixs	Portal, flexible screen phablet	This flexible screen phablet slides into a dual-strap arm cradle that extends about halfway up the forearm from the wrist.	Evolving
Cricet	Cicret bracelet and on-skin display	A bracelet that projects smartphone on the user's forearm. It is controlled and moved by touching your skin.	Evolving
Kyocera	Proteus collapsible, wearable smartphone	A flexible smartphone that can collapse and become a wearable, likely with an AMOLED display.	Evolving
Proglove	Proglove	The device features Intel-Edison sensors in the fingers, a computing core and display.	Evolving
Power			
Chargers/Batteries			
BAE Systems	Broadsword	The suit includes woven fabric that conducts electricity and transmits data without cords. The suit is powered by a flexible battery along its wearer's spine that recharges each time the user sits down on a charging pad.	Evolving

Company	Technology	Description	Status
KAIST	Wireless charging system using Dipole Coil Resonant System (DCRS)	Wireless power transmission technology called the Dipole Coil Resonant System (DCRS) allows you to recharge devices in range of a "Wi-Po Zone."	Evolving
Nifty	XOO	Belt features Lithium Ceramic Polymer flexible battery, can carry 2,100 mAh of power, and includes USB ports.	Evolving
Panasonic	Pin-Shaped Lithium Ion Battery	As the industry's smallest cylindrical-shaped rechargeable Lithium ion battery (a diameter of 3.5mm and a weight of 0.6g), this product features the high reliability and high output required for near-field communications.	Soon to be released
Samsung	Bendable battery and pill-sized battery	Samsung's thin, rollable, bendable battery can wrap around a person's wrist or bend into a U shape and still operate normally. Samsung also announced a tiny pill battery with the capacity up to 5 times higher than any batteries mounted to the smart bands.	Evolving
UBeam	Ultrasound charger	This technology can take electricity, convert it into sound, and send that audio through the air over ultrasound. A receiver attached to a portable electronic device catches the sound and converts it back into electricity.	Soon to be released
Self-powering/Harvesting			
A*Star Institute of Microelectronics (IME)	Implantable energy harvester	This technology uses low frequency vibrations to power small-scale electronic devices.	Evolving
AMPY	AMPY wearable kinetic device	The AMPY wearable kinetic device lets users discreetly capture and convert their daily physical activity into charging power for their smartphones.	Soon to be released
Columbia Engineering and the Georgia Institute of Technology	Piezoelectric nanogenerators	Researchers discovered a radical new way to create electricity using an atom-thin generator. It produces electricity when bent or stretched, and researchers say it could be sewn into clothing and even used in medical implants	Evolving
Fudan University, China	Wearable supercapacitor textile	A high-performance Li-ion battery made of carbon nanotube fiber yarns. A novel wearable supercapacitor textile that is thin, lightweight, transparent, and flexible. The supercapacitor textile is further integrated to create a new energy textile that can convert solar energy to electric energy.	Evolving
Georgia Institute of Technology	Self-powered nanosystem	Materials that harvest operating energy from a host (i.e., the human body) may be feasible.	Evolving

Company	Technology	Description	Status
KAIST	Glass fabric-based flexible thermoelectric (TE) generator	The glass fabric-based thermoelectric (TE) generator is light-weight, extremely flexible, and produces electricity from the heat of the human body.	Evolving
Pauline Van Dongen	Wearable solar	Garments produce sustainable energy through integrated solar cells.	Evolving
Rajesh Adhikari	Power-generating footwear	These functional shoes contain a small dynamo that charges up and produces 5 volts of electricity as the wearer walks or runs.	Evolving
Sungkyunkwan University	Perovskite solar cells	Perovskite solar cells are candidates for realizing an efficient, flexible, and lightweight energy supply system for wearable electronic devices.	Evolving
Tommy Hilfiger	Solar-powered jacket	Jacket with solar panels and chargeable battery that can fully charge a standard 1500mAh mobile device up to four times.	Available
U.S. Marine Corps Expeditionary Energy Office (E2O)	Marine Austere Patrolling System, or MAPS	A vest that consists mainly of a solar-energy harvesting and storage system and water-purification unit.	Evolving
Power Supply			
Acticheck	Assure	The standout feature of the new device is a battery life that provides power for 2 years without recharging.	Soon to be released
Drexel University, Dalian University of Technology	Mxenes, Electrically conductive, flexible nanomaterial	Electrically conductive nanomaterial, flexible enough to fold but strong enough to support many times its own weight. Believed to be used to improve electrical energy storage.	Evolving
MIT	Stretchable supercapacitors with graphene paper	Stretchable supercapacitors can store energy for flexible electronic devices. Crumpled-graphene papers present a simple and low-cost method for extremely stretchable and high-performance electrodes for supercapacitors.	Evolving
Mixel	Controller	Mixel's high-performance, low-power Rx D-PHYSM and Northwest Logic's full-featured, small-size CSI-2 Rx Controller Core minimizes power and area.	Available
Samsung	Wearable energy sharing devices	Samsung's invention shares energy between wearable devices.	Evolving
Taiwan Semiconductor Manufacturing Company Limited (TSMC)	Ultra low-power technology platform	TSMC's ultra-low power processes can reduce operating voltages by 20% to 30% to lower both active power and standby power consumption.	Soon to be released
TE Wearables Lab	Wireless power development kit	2.5W charger with integrated magnet for attachment to a wearable device.	Available
Integrated Communications			

Company	Technology	Description	Status
Bluetooth			
OnBeep	Onyx wearable communicator badge	Round clip-on wearable equipped with speakers, an LED light, and an activation button that allows users to communicate via Bluetooth and over smartphone's data connection.	Soon to be released
Yak Hat	Yak Hat	Bluetooth 4.0 integrated into the hat offers wireless connectivity to the user's smartphone.	Evolving
Hands-free Operations			
16Lab	Smart ring	A titanium ring with a somewhat pointy protrusion made up of dual touch surfaces. To activate the ring, you simply hold your thumb on either one. The ring vibrates subtly and is now awaiting your command. You can wave it up and down, twist your hand left or right, or basically move the ring freely in 3D space.	Soon to be released
Easier to Use	GoGlove wireless remote control	A Bluetooth module in the glove is connected to sensors in the fingertips. Used to control your phone.	Evolving
Elliptic Labs	Touchless gesturing with ultrasonic technology	The device uses ultrasonic technology that recognizes gestures and allows for touchless interaction.	Evolving
Murata	Crystal unit	With an overall frequency precision of +/-20ppm, these miniature crystal units are can support the stringent frequency tolerances required for wireless communications such as LTE/3G, Wi-Fi, Bluetooth, Bluetooth Low Energy, ZigBee, and NFC.	Available
Mycestro	Wearable wireless mouse	A wearable, wireless 3D mouse worn on the finger delivers all of the same functionality as a traditional mouse with increased mobility.	Available
Exoskeletons			
Defense Advanced Research Projects Agency (DARPA)	Airlegs	The power pack provides power to movement (like running) from a tank of compressed air connected by pulleys and electronic sensors to braces on the knees.	Evolving
Ekso	Body suit	The suit works by powering steps when the wearer shifts his or her weight.	Available
Harvard Wyss Institute for Biologically Inspired Engineering	Soft Exosuit	The Soft Exosuit can be worn comfortably under clothing and could enable soldiers to walk longer distances, keep fatigue at bay, and minimize the risk of injury when carrying heavy loads.	Evolving

Company	Technology	Description	Status
Purdue University	Robotic fabric	The robotic fabric is a cotton material containing sensors made of a flexible polymer and threadlike strands of a shape-memory alloy that return to a coiled shape when heated, causing the fabric to move. Such an elastic technology could make possible robots that have sensory skin, stretchable robotic garments that people might wear for added strength and endurance, etc.	Evolving
StretchSense, I Measure U	Bionic limbs and sensors	Bionic limbs to give people more capability than they were born with.	Evolving
Tokyo University of Science and Innophys Co.	Muscle Suit wearable power-assist device	The Muscle Suit, weighing 5.5 kilograms (12 pounds), can be worn knapsack-style and uses a mouthpiece as its control. The Muscle Suit can help users pick up everyday loads with about a third of the usual effort.	Soon to be released
Wearable Computers			
Raytheon	Wearable computer	The new technology merges proven, wearable computer systems with situational awareness capabilities to create an enhanced real-time view of the battlefield for commanders and their troops.	Evolving
Tufts University	Passive physiological input	The proposed interface uses passive physiological input as additional communication channels between wearable devices and wearers.	Evolving
University of Canterbury	Wearable computer interface design	Researchers are exploring how models of human cognition can be adapted for wearable computer interface design, particularly how to use models of human attention to create wearable interfaces that do not distract the user.	Evolving
General			
Actuate	BIRT iHub 3.1 and BIRT Analytics 5.0	The applications help users turn wearable-generated data into usable information and value-added visual representations.	Soon to be released
Allied Minds Seamless Devices, Inc.	Seamless Devices analog signal processing	Applications for a novel technique in analog signal processing that will make it possible to produce high-performance signals even as transistors are scaled down in size deep into the nanoscale.	Evolving
Alpinestar	Tech-Air street system	Tech-Air street system works like a lining for bike jackets. When the system detects an impact, a built-in canister and 'bladder' inflates to protect the wearer's body.	
Arco	Smart Reactor	The Smart Reactor uses white and RGB LEDs to handle different types of notifications.	Evolving
ARM Holdings	MBED OS	The operating system is meant to resolve productivity problems that arise from fragmentation—where different devices in the so-called "Internet of things" (IoT) market run on a mix of different protocols. ARM aims to consolidate those devices under a single software layer that's simple, secure, and free for all manufacturers to use.	Soon to be released

Company	Technology	Description	Status
Betatrac	eBodyGuard	The eBodyGuard interactive composite jacket equipped with GSM/GPRS/GPS and a miniature camera. The technology can track people and assets in real time and monitor voltage, speed, movement, temperature and location – which is overlaid on a map.	
Body Biolytics	Predictive analytics software	Software to correlate the information gathered by wearables.	Evolving
Clone Algo	Artificial intelligence chip-embedded clothing	Wearable devices that will use artificial intelligence in chip-embedded clothes to reduce the usage of hand-held tools.	Evolving
DOCTO	DOCTO	DOCTO is an app that complements medical sensors and fitness wearables by applying biometric analysis to provide diagnostics to the user.	Evolving
Ducere Technologies	Lechal Bluetooth-enabled haptic shoe	The Lechal shoe uses haptic technology and digital mapping to signal the wearer through vibrations, the intensity and duration of which vary to correlate with the distance to an upcoming turn.	Soon to be released
Eidos	Eidos Vision and Audio	The visual device overlays what the user is seeing with images recorded just a few milliseconds ago. The effect is similar to time-lapse video, only in real time. The user can see moving objects more clearly and determine patterns in them. The audio device allows users to isolate sounds, screening out background noise	Evolving
FacialNetwork Inc.	Orbit cloud-based facial recognition	Orbit is a cloud-based facial recognition app designed for facial recognition authentication on mobile devices.	Evolving
Google	Smart contact lenses	These specially designed contact lenses measure the glucose levels in diabetics' tears and send that data to a mobile device. The contacts are fitted with wireless chips and glucose sensors that are able to measure blood sugar levels once per second.	Evolving
Imagination	PowerVR Series 7 graphics processor unit	The XT provides more graphics processing power than its predecessors while using lesser or the same amount of power.	Soon to be released
Ineda Systems	Low-power system-on-chip	Ineda's ground-up architecture is optimized for long battery life, along with the scalable performance that is required to run the various applications in the wearable and IoT space.	Evolving
Institute of Textiles and Clothing	Fabric circuit board	This fabric circuit board is made of pre-stretched elastic yarn and polyurethane-coated copper fibers.	Evolving
Invensense	Single-chip MotionTracking	InvenSense® single-chip MotionTracking™ solutions combine micro-electromechanical system, or MEMS, based motion sensors, such as accelerometers and gyroscopes, with mixed-signal integrated circuits to improve performance, accuracy, and intuitive motion- and gesture-based interfaces.	Available
iStrategyLabs	Dorothy with a "ruby" sensor	Dorothy's "ruby" sensor is placed inside a shoe and when tapped three times it sends a fake call to the user and can also send custom texts to contacts, notifying them of the user's location.	Evolving

Company	Technology	Description	Status
Karen Janssen	HERE for Gear navigation app for smartwatches	Navigation app offers turn-by-turn pedestrian navigation and public transit routing fit for display on smaller (2-inch) screens or smartwatches.	Available
Korean Agency for Technology Standards	Standards	Establishing a standard-setting committee for wearable smart devices. The agency suggested a total of 18 international standards in the areas of semiconductor (9 standards), display (5), and electronic printing (4).	
Lineable	Lineable wearable beacon	Lineable is an iOS-compatible tracking bracelet that allows parents to keep track of children. Parents or guardians can use mobile devices to monitor children within that area; if children leave the area, users are immediately notified.	Soon to be released
MEU	MEU square wearable LED display	The product brings the ability for users to display any text, image, or pattern in order to communicate a message with people around them.	Evolving
Microsoft	Bone-conduction headset	Bone conduction delivers sound to the inner ear, using your skull as a delivery method.	Evolving
Myo-systems	PurePhones	The device uses sound to “trick” the brain into hearing something that is not actually there. This “phantom noise” causes the brain to elevate its operating speed to maintain homeostasis.	Evolving
Nanyang Technological University	Flexible wearable electronic circuits	T-shirt printing equipment prints transistors, capacitors, and resistors onto materials such as paper, fabric, plastic, and aluminum foil.	Evolving
National Physical Laboratory	Smart textiles	Integrating electronics into all types of clothing made simple and practical by enabling lightweight circuits to be printed directly onto complete garments.	Evolving
Ohio State University	Textile wearable antenna	The textile antennas are made from embroidered conductive fibers, referred to as E-fibers, that offer high surface conductivity (nearly equivalent to copper), are flexible and mechanically strong, and can be inconspicuously integrated into the garments.	Evolving
OrginGPS	Nano Spider	The Nano Spider tracks GPS satellites to provide real-time positioning data.	Evolving
Ramco	Enterprise resource planning (business management) software	Enterprise resource planning (business management) software fit for use with wearable such devices.	
Re-Time	Re-Timer glasses to combat jetlag	Re-Timer sits on your face like a pair of glasses and blasts UV-free green light into your eyes to help adjust circadian rhythms, or ‘body clock’, helping to reduce the effects of jetlag.	Available
Soundhawk	Soundhawk	Hearing device that cuts through background noise, focusing on the speech of the person the user wants to hear.	
Tech Museum of Innovation Body Metric Exhibit	Integrated full-body kit	The Body Metrics Exhibit measures social, physical, and emotional aspects of museum visitors in real-time.	Available

Company	Technology	Description	Status
Toshiba	TZ1021MBG App Lite™ application processor for wearable devices	Integrates a processor, Flash memory, low-power consumption, and highly sensitive analog to digital converters (ADCs) well-suited for measuring weak biomedical signals such as the pulse and the heart's electrical activity (like an electro-cardiogram).	Soon to be released
Tsinghua University	iGaze headset	This wearable, head-mounted computer tracks your gaze and connects to devices just by looking at them.	Evolving
University of Adelaide	Wearable antenna	Antennas that be incorporated into clothing using computerized embroidery into conductive fabric.	Evolving
University of California	Hush smart earplugs	The earplugs use noise-masking to block outside sounds and integrate with a smartphone via an associated app. Users achieve complete silence, without missing important updates and alarms on mobile devices.	Soon to be released
University of Texas	Memory nap controller	Researchers propose a technique that reduces the static power consumption in caches with no side effect on processor performance.	Evolving
University of Tokyo	Ultraflexible circuits	Circuitry printed on ultraflexible plastic substrates that can withstand bending and crumpling.	Evolving
Viametrica and SensorUp	Aggregation platform for fitness trackers	Vivametrica and SensorUp have formed a partnership to collect, standardize, and integrate data from wearable devices for application in healthcare environments.	Evolving
Visual Intelligence	iOne sensor technology	Miniaturized imaging technology that provides ultra-high resolution and multi-sensor functionality may allow for powerful multi-function imaging system with features such as infrared, night vision, ultra-high resolution, engineering-grade metric imaging, and image fusion.	Evolving
Wearable Experiments	Navigate GPS jacket	The jacket directs the wearer with subtle vibrations, indicating when they need to turn right to get to their desired destination.	
Zikto	Arki wristband	Measures gait biometrics, a person's walking patterns, to authenticate identity.	Evolving



Pacific Northwest
NATIONAL LABORATORY

*Proudly Operated by **Battelle** Since 1965*

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99352
1-888-375-PNNL (7665)

U.S. DEPARTMENT OF
ENERGY

www.pnnl.gov