New Study Session proposal for wearable systems and equipment

Market trends and use cases for wearable systems and equipment

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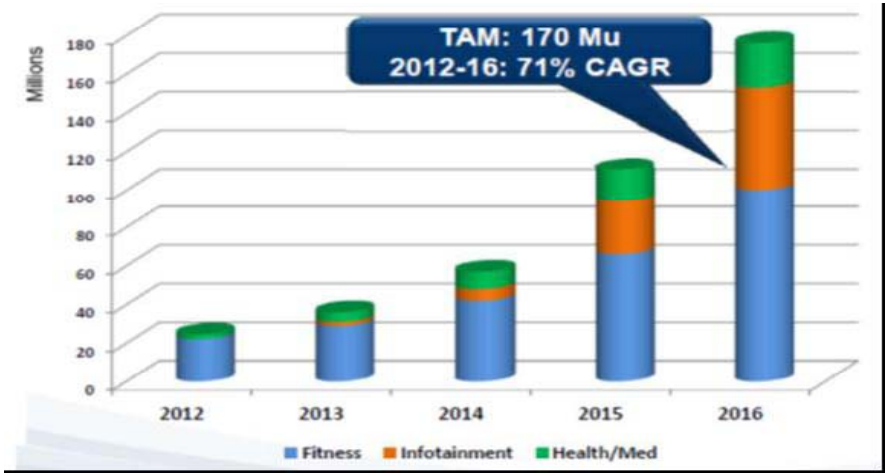
Market Trends

Strategy Analytics (1)

1. Wearable is defined as: a mobile phone / tablet companion-device or standalone-device worn on-body or in-clothing
2. Splits the market between the major currently-known categories (e.g. watches, glasses, fitness bands, smart clothing)
3. Fitness bands are dominant device class in 2013 (91%)
4. Today key players of smartwatch: Samsung and Sony
5. Tomorrow players: Apple, Google, Intel and Microsoft
6. Wearable devices a 125M unit market in 2017
7. Existing apps focus on mobile phone connectivity
8. The “wearable” is not yet a stand alone device

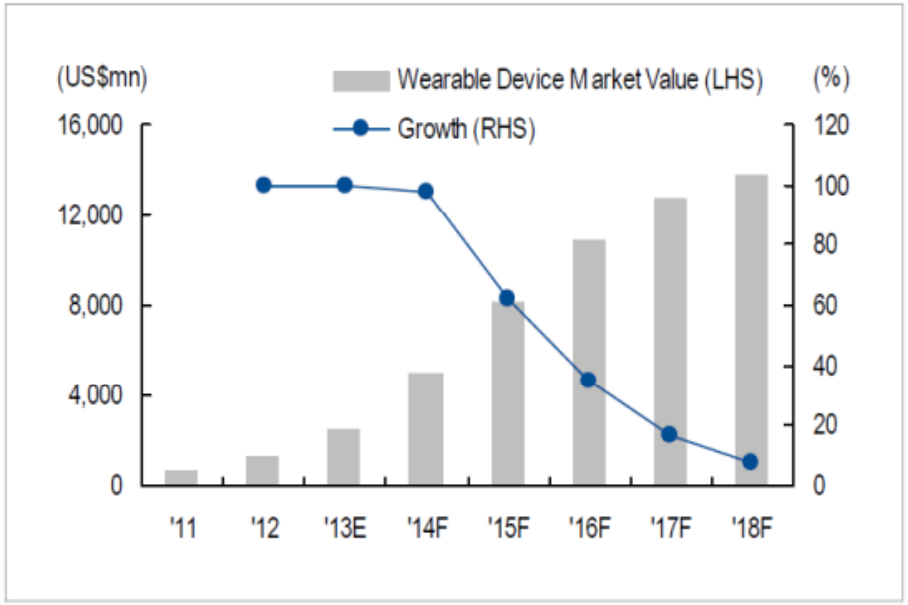
Market Data (2)

1. Invensense: total worldwide market for wearables expected to reach 170M units by 2016, up from less than 20M in 2012.
2. Major use-case centered around
    1. Fitness
    2. increasing portion would be targeting infotainment (whether at home, in mobility or in transport)
    3. And more healthcare/medical use-cases



Market Data (3)

1. Woori I&S: Global Wearable Device Market to grow 40% per-year to reach over 14B$ by 2018 (compared to 5B$/43 M units in 2014)



Source: Woori I&S Research Center

Market Data (4)

1. Display Search: Total global market for wearable device expected to reach 485M un

Market Data (5)

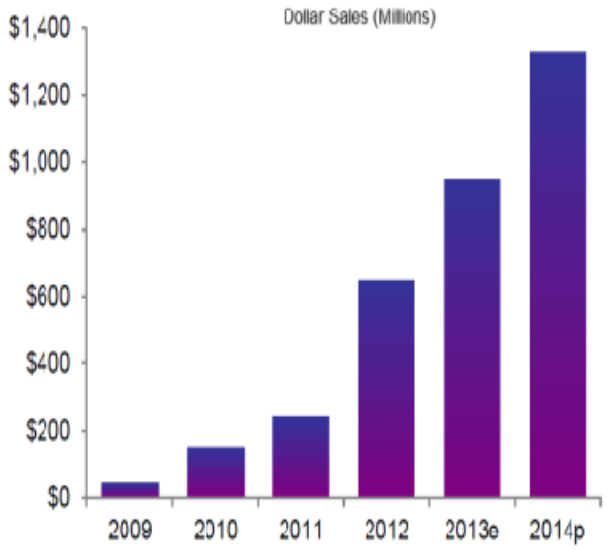
1. CEA (Consumer Electronics Association): Wearable device sales in the US reaching 1.33B$ in 2014, with the following split
    1. Smart Watches: 960K units
    2. Fitness bands: 12.8M units

Fig. 9.1 CE Wearables Total

Sales to Dealers

	Dollar Sales (Millions)
2009	$43
2010	$152
2011	$240
2012	$649
2013e	**$949**
2014p	**$1,329**

Includes: Smartwatches and Fitness Technology



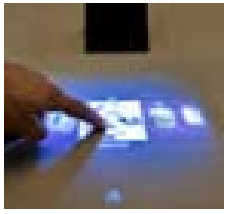
Use Cases

(based on ARM report)

Use Cases

Wearables as

- Key
- Emotion Recognition
- Energy Harvesting
- Next TV Screen
- Fashion and Textile
- Augmented Projector
- Human-Body Communication



Wearable as *Key*

1. Especially in the context of connected cars, several manufacturers have started to investigate the possibility to replace the old-fashioned key fob in favor of wristbands, watches or other wearables.

   1. Nissan showcasing its Nismo Watch prototype at the Frankfurt Motorshow in Fall 2013
   2. BMW partnering with Samsung to include car-specific features into Samsung's Galaxy Gear
   3. Hyundai using Google Glass to remotely lock/unlock its sedan cars
   4. Mercedes partnering with Pebble Smart Watch to display contextual information on the state of the vehicle

2. While the mass-market appeal is today shown around the application in cars, a similar approach could be seen for home especially with the advent of Bluetooth-enabled smart locks, as well as thermostats such as Nest/Google, enterprise (access control in buildings) and public transportation.

Wearable as *Emotion Recogniton*

1. In addition to the "objective" harvesting of user's position/temperature/angle (or other biometrics data), another major opportunity lies in the "subjective" capturing of emotions (especially in the case of smart glasses or other wearables encompassing (some of) the user's face).
2. Most of those technologies were initially developed for stationary applications (such as Connected TVs with built-in camera) for audience measurement and advertising re-targeting usages, but could be easily adapted for wearables (especially in case most of the computing-intensive processing lies remotely in the Cloud).

1. Emotion developing a software-based framework for facial expression recognition (http://www.emotient.com/products).
2. Affdex integrating its proprietary facial de-coding and emotion clustering for brand & advertising (http://www.affdex.com/technology/affdex-facial-coding/).

Wearable as *Energy Harvesting (1)*

1. One of the continued limitations of wearable devices lies in power consumption and extending those new devices' autonomy.
2. Moreover, the already-developed wireless charging mechanisms (such as the Wireless Power Consortium (WPC) and the Alliance for Wireless Power (A4WP)) naturally find a fit into wearable devices.

1. Australian National University developing thin solar cells that could be integrated into clothes, smart watch wrist bands etc. (http://sun.anu.edu.au/sliver).
2. GCell developing thin solar cells that could be directly integrated into wearable devices (http://gcell.com/gcell-products).
3. Wearable Solar (start-up from Netherlands) weaving solar cells into outer wear to provide energy for companion devices (http://wearablesolar.nl/).

Wearable as *Energy Harvesting (2)*

1. IMEC in Belgium developing MEMS (piezo-electric vibration sensor) energy harvester, with enough power to be used in car applications (e.g. into tires for getting energy from tires hitting on the asphalt) (http://www2.imec.be/be_en/press/imec-news/imeciedmitire.html).
2. Holst Centre in Netherlands integrating a thermo-electric generator (Peltier physical effect) into a wearable shirt (http://www.holstcentre.com/en/NewsPress/NewsList/shirt_thermoelectric_generator.aspx)
3. Wuhan National Laboratory for Optoelectronics in China developing cotton threads that act as a capacitor and can therefore store electrical energy into clothing (http://en.wnlo.cn/category/44/2013-08-16/18227978.html).
4. Ecole Polytechnique of Montreal in Canada developing a flexible, textile-woven lithium battery prototype (http://www.photonics.phys.polymtl.ca/papers/JES_Flexible_Textile_Battery.pdf).

Wearable as *the Next TV Screen (1)*

1. While multi-screen content consumption relying on smartphone and/or tablets as companion devices to the larger TV screen (a trend which has benefited both traditional Cable/Satellite/Terrestrial broadcasters as well as Over-the-Top streaming services), one potential new trend is to further increase the "stickiness" of TV/Video-on-Demand viewing through wearable devices.
2. Example use-cases could include:
    1. More advanced voice recognition (i.e. using Natural Language Processing)
    2. Dynamic 3D sound (i.e. using microphones or audio sensors to detect user's position in the living room or in mobility, a bit akin to what Dysonics does with its pluggable sensor on headphones http://www.rondomotion.com/)
    3. Background content discovery (i.e. smart glasses capturing scenes from what has been "bookmarked" by the user's eyes during the day, and using this as input parameters for Cloud-based content recommendation)

Wearable as *the Next TV Screen (2)*

1. Truly split-screen multi-dimensional watching (i.e. wearable devices becoming integral part of the storytelling platform – such as characters running off the main screen while the action continues on the individual screen or providing overlaid contextual information for live sport).

Wearable as *Fashion (1)*

1. More generally, the fashion industry is starting to embrace the opportunity of connected wearable devices, as exemplified by the following initiatives:
    1. Netatmo's JUNE bracelet designed by Louis Vuitton (http://www.netatmo.com/en-US/product/june).
    2. Pebble Steel smart watch as the 1st truly "nice looking" watch with exchangeable metal & leather straps (https://getpebble.com/steel).
    3. EZIO launching a line-up of designer smart watches (that look like "regular" luxury watches) (http://www.eziolifestyle.com/products_watch.html).

Wearable as *Fashion (2)*

1. Fashion designer Asher Levine including Bluetooth tracking chips that let couture clothing items be located by the owner using a customized TrackR app. (http://www.trendhunter.com/trends/asher-levine).
2. Germany-based label Moon Berlin, which makes luxury clothing, focuses on using technology to enhance the look of its designs. Soft-circuit LEDs are integrated into the garments, connected to an electrical circuit attached to rubber-like materials that are integrated into fabrics. (http://www.moonberlin.com/menu#!__menu/collection).
3. MEMI launching a nicely-designed bracelet for pairing with smartphones for women (http://www.hellomemi.com/about.html).
4. Fitness tracker company Fitbit is teaming with designer Tory Burch for a stylish line of trackers (http://techcrunch.com/2014/01/07/fitbit-partners-with-tory-burch-for-high-fashion-accessories/).

Wearable as *Textile (1)*

1. Beyond just putting display and input/output user interface on a wearable form factor (as a separate device), another very active area lies into integrating (some of those) features right into textile fabric, so that wearables are no longer "yet another" device to carry, but naturally embedded into everyday clothing.

1. Heapsylon (start-up formed by former Microsoft Xbox engineering people) designing e-textile sensors for fitness and sport measurement (http://www.heapsylon.com/about/).
2. Citizen (French start-up) developing customized chipset and sensors woven into fabric and textile for both consumer and industrial applications. For instance, showcasing the aggregation of sensors (e.g. humidity, temperature, gyroscope…) into a sports jacket, and possibility to further integrate additional active electronics (e.g. NFC, Zigbee, Bluetooth LE…) into textile. (http://www.cityzensciences.fr/).

Wearable as *Textile (2)*

1. Research project from Concordia University Canada and the University of London on clothing dynamically adjusting their appearance based on the user's mood and emotions (http://www.wearableabsence.com/#/home).
2. Diffus (design house from Denmark) embedding UV and light sensors into outer-wear and adjusting the fabric to protect user's skin (http://www.diffus.dk/portfolio/uv-dress/).
3. Microsoft Research experimenting with underwear reacting to user's emotional state (and paired with smartphone mobile app.) (http://www.cs.rochester.edu/hci/pubs/pdfs/FoodMood.pdf).

Wearable as *Augmented Projector*

1. Advances in projection can be imagined, which could enhance the visualization and display capabilities for wearable devices.
    1. Microsoft Research developing a wearable projector which can project onto walls, as well as aware of user's presence in the 3D space (http://research.microsoft.com/en-us/projects/augmentedprojectors/).
    2. DoCoMo implementing real-time object recognition and image extraction in its smart glass prototype, notably for providing dynamic translation of text from Japanese to English (http://technabob.com/blog/2013/10/04/translation-smart-glasses/).
    3. Intel demonstrating 3D camera with dynamic depth detection – while this is first to be integrated into legacy laptop devices, a longer-term opportunity lies in its embedding into smart glasses (http://www.intel.com/content/www/us/en/architecture-and-technology/realsense-overview.html).

Wearable as *Human-Body Communication*

1. Body Area Network (BAN) emerges as the natural byproduct of existing sensor network technology and biomedical engineering. While first seen as a standalone extension of using human body as a networking medium, the conjunction of BAN together with Body Sensor Network (BSN) as provided by wearables may help create a stronger use-case.
2. Most of the activity evolves around adaptation of IEEE 802.15 TG6 BAN draft standard (http://www.ieee802.org/15/pub/TG6.html) as well as ISO/IEC17982

1. Microchip unveiling its "BodyCom" as end-to-end framework to use human body as a secure communication channel (using capacitive coupling) (http://www.microchip.com/pagehandler/en-us/technology/embeddedsecurity/technology/bodycom.html).
2. Ericsson showing capacitive transceivers for BAN, stemming from university research in Sweden (http://www.es.isy.liu.se/research/BAN/).

Benefits of Wearable technologies/devices for health and AAL

1. Make personal fitness more fun (gamification)
2. Educate and empower patients to take control of their health (self-awareness)
3. Help physicians and patients monitor and diagnose disease (telemedicine and telemonitoring)
    1. E.g. wristbands that can track heart rate, monitor activity level during the day, detect falls, provide location information and send a
4. Allow patients to control and manage their pain (life imp
5. Assist in medical procedures (process optimization)
6. Enhances Doctor-Patient Interactions (relationship en

Findings with respect to standardisation requirements

1. Surveys and research are more generically considering the M2M space (for B2B/B2B2C applications, rather than B2C usages)
2. Wearables are part of the broader M2M landscape
3. Initiative of Qualcomm in the Allseen Alliance (https://allseenalliance.org/) puts some software stacks as open source
4. Broader interoperability at hardware/software/service layers required
5. "Societal" acceptance of wearables is a challenge
6. Wireless charging and battery management are key topics

Role of TC 100

1. Survey of wearable technologies, use cases and research projects
2. Inventory of wearable related standards, e.g. M2M
3. Survey every possibility of standardization under TC 100 scope
4. Proposal to establish a new study session on wearable technologies in AGS