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# *Introduction to wearable technology*

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*What do you have in mind when you think about wearable?*









## FROM HEAD TO TOE WEARABLE TECHNOLOGY

### SHIRT

Conductive thread means a computer is literally built into the fabric of the shirt, providing the processing power for all the other wearable gadgets.

### WRISTBAND

A sensor that tracks movement to determine the number of steps taken through the day – 10,000 is ideal – and how much sleep the wearer gets at night.

### TROUSERS

Also made with conductive thread, the trousers take the energy generated by movement and use it to power the other gadgets.

### GLASSES

Overlays navigation directions and information about points of interest directly on to the wearer's field of vision.

### WRISTWATCH

Vibrates when a message arrives and displays it on the watch face. Tells the time too.

### HAND

Embedded under the skin is a chip containing medical records, passport data and credit records. Information is transferred by waving the hand over a suitable scanner.

### SHOES

GPS chip provides directions using LED lights in each shoe: the left shoe indicates direction, while the right shows distance.

GRAPHIC: JOHN BRADLEY

## WEARABLE TECHNOLOGY: SHAPING THE FUTURE OF YOUR HEALTH CARE

Do you own one of the 19 million wearable fitness trackers shipped in the U.S. in 2014? Discover eight reasons why more than 60% of doctors recommended their patients use a wearable.

### SELF-AWARENESS

With a wearable, patients are more aware than ever of their habits, their exercise and their progress.

### HEALTH MANAGEMENT

Wearables allow users to set goals, reminders and incentives to stay on the path of healthy living.

### TREND IDENTIFICATION

Your activity trends directly correlate to your diet. Wearables help users track their activity and plan meals around their activity levels.

### ADHERENCE

By setting goals and timelines, wearable users are more likely to stick to a regime.

### OBJECTIVE DATA

Wearables are able to provide your doctor with a clear, objective picture of your activity level.

### WEIGHT LOSS

Obesity is a growing problem in the U.S. Wearables show you the steps to take and types of food to eat, along with tracking your weight loss.

### ACCOUNTABILITY

Wearables help you remain accountable and honest with yourself about your progress, keeping you on the right track.

### MOTIVATION

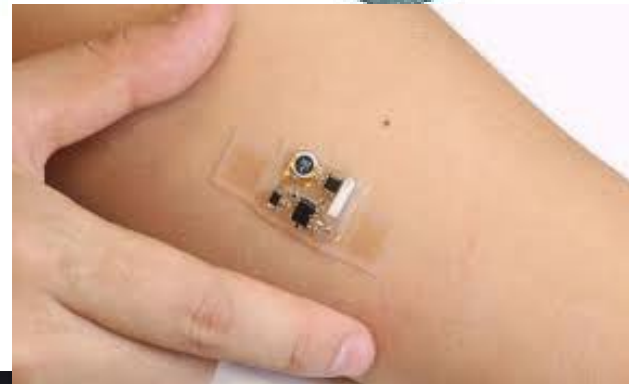
Today, wearables are the new motivators. Users are able to set reminders and are alerted if they sit too long.



UnityPoint Clinic

[UnityPoint.org/Clinics/WearableTechnology](http://UnityPoint.org/Clinics/WearableTechnology)









# Augment Ourselves







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But  
Wearable Tech  
isn't new



A close-up photograph of a roulette wheel. In the foreground, a polished metal croupier's mallet stands vertically. The roulette wheel is visible in the background, showing numbers 29, 7, 28, 12, 35, and 3. A small white roulette ball is resting on the wheel. The text "1961: First wearable computer to help winning the roulette" is overlaid on the right side of the image.

1961: First wearable  
computer to help  
winning the roulette

# What is a wearable object?



- Something smart that you can wear
- A set of sensors and actuators that can interact with you or your smartphone
  - wearables as extension of user mobile device
- *"An extension of yourself"*
- A small, but powerful, computer in your pocket or mounted in your bracelet, glasses, etc



# What a wearable is not



- Wearables are not a replacement of mobile devices
  - Wearables complement mobile devices and can even depend on them
  - Android wear watches cannot connect to the Internet and download apps without being connected to a mobile devices
- Wearables are not suitable for all
  - They are perfect for quick interactions like setting an alarm, but not suitable for more complex action like writing an email
- More accessible than mobile devices in particular situations

# What can be done with wearables?



- It depends on several factors:
  - Type of device
  - Sensors
  - Actuators
  - Operating systems and APIs
- Some examples:
  - Monitor vital signs
  - Monitor movements and gestures
  - Notify about important things
  - Overlay information right in front of your eyes
  - Capture data from the environment (light, sound)

# Several application fields!



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- Fashion
  - U2 use leather jacket with embedded LEDs





# Several application fields!



- Fashion
  - U2 use leather jacket with embedded LEDs
- Military Field
- Healthcare
  - Monitoring and support for patient's autonomy
  - Fitness & Wellness
  - ...
- Workspace
  - security
- Infotainment
- Time

# TYPES OF WEARABLES IN HEALTHCARE

The mix - Healthcare, Medical, Fitness and Wellness

Sleep Sensors



Audio Earbuds



Smart Glasses



Hearing Aids



Heads-up Displays



Defibrillators



Smart Clothing



ECG Monitors



Fitness & Heart  
Rate Monitors



Activity Monitors



PERS



Smart Watches



Drug Delivery  
Products



Continuous Glucose  
Monitoring



Patches



Insulin Pumps



Blood Pressure  
Monitors



Pulse Oximetry



Emotional  
Measurement



Foot Pods &  
Pedometers





# Wearable Technology Market: Key Industries 2012-2018



- Many wearables, many SDK!
  - Unfortunately, an open standard does not exist
  - Many wearable comes with its operating system and developers must download its SDK from the manufacturer
- NO cross-platform framework for wearables!
- Android Wear tries to solve the problem

- Android Wear is an operating system specific for the wearable realm
- It's like Android but tiny
- The idea: to create an OS for wearable which can easily sync with other Android devices
- An Android Wear device can do (almost) anything that a phone can do. The biggest difference is the form factor.
- Design Considerations Are Important!



# Round or squared?



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# Round or squared?



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# Suitable for ...



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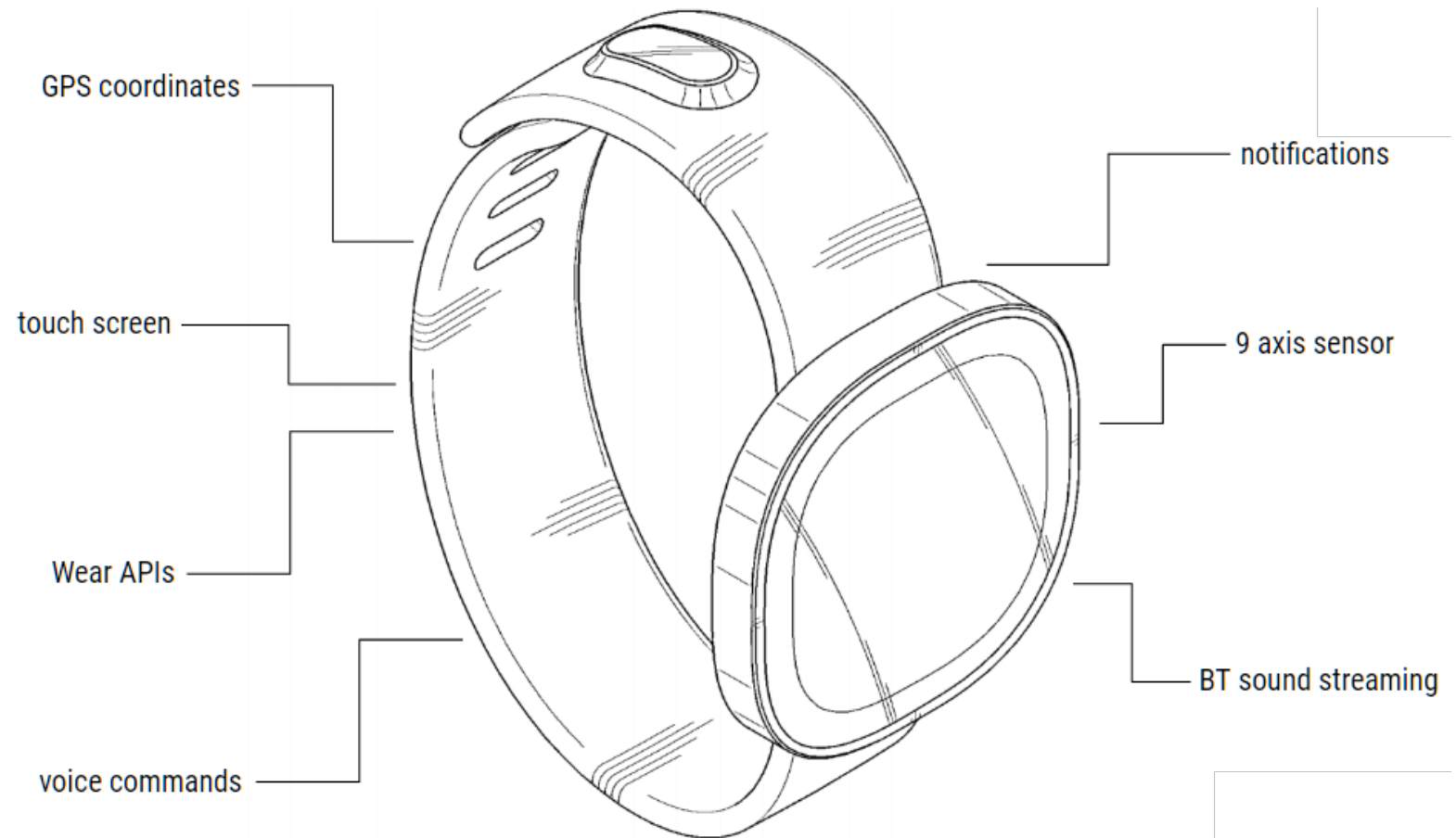
- Quick interaction (accept/decline, swipe, tap, etc)
- Notification
- Display short message
- Collect data (number of steps, gestures, etc)



# Hardware equipment

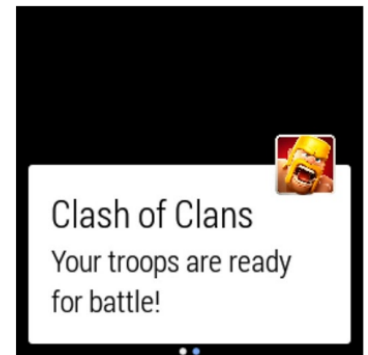
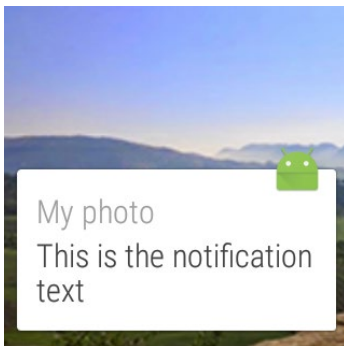


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- To develop applications for Android Wear you need:
  - Android Studio
  - Android Wear SDK
  - An Android smartphone and an Android Wear device

*Applications are not usually developed for wearable devices, but they extend functionalities provided by smartphones apps*



# Simple example: a button



The screenshot displays the Android Studio IDE with the following components:

- Menu Bar:** File, Edit, View, Navigate, Code, Analyze, Refactor, Build, Run, Tools, VCS, Window, Help.
- Toolbar:** Standard Android Studio icons for file operations, running, and debugging.
- Project Explorer (Left):** Shows the project structure for 'app1' with folders for 'wear', 'src', 'main', and 'java'. The 'wear' folder is expanded, showing 'manifests', 'java', and 'res' (containing 'drawable' and 'layout').
- Code Editor (Center):** Displays the code for 'MainActivityWear.java'. The code defines a class that extends 'Activity', initializes a 'TextView' and a 'Button', and implements the 'onCreate' and 'onClick' methods. The 'onClick' method sets the button text to 'I'm clicked!!'.
- Preview Window (Right):** Shows a visual representation of the app's UI. It features a dark background with the text 'Hello Square World!' and a button labeled 'I'm clicked!!'.
- Status Bar (Bottom):** Includes tabs for 'Terminal', 'Android', 'Messages', and 'TODO'. The bottom right corner shows the time '36:32' and the encoding 'UTF-8'.



- Android Wear allows to:
  - design our own Watch Faces

# Watch Faces



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- Android Wear allows to:
  - design our own Watch Faces
  - create special notifications (short messages) from our normal apps
  - create novel interactions (e. g., voice input, gestures)
  - give feedback to users through vibration
  - ... etc...

# Collecting data from sensors



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- A small Android wear device can be equipped with even more than 15 sensors

TABLE 10-1: Sensors Available on the LG G Watch

NAME	TYPE	DESCRIPTION
STMicro 3-axis Tilt Sensor	Software	
MPL Gyroscope	Hardware	
MPL Raw Gyroscope	Hardware	
MPL Accelerometer	Hardware	An accelerometer sensor that includes the gravity force.
MPL Magnetic Field	Hardware	
MPL Raw Magnetic Field	Hardware	
MPL Orientation	Software	An older-style sensor that has been deprecated and is on its way out of the Android system. You should use the Rotation Vector instead.
MPL Rotation Vector	Software	Gives a rotational unit vector based on the East-North-Up coordinates.
MPL Game Rotation Vector	Software	Similar to the Rotation Vector, except that it uses different underlying hardware. This also means that the sensors report different values.
MPL Linear Acceleration	Software	An accelerometer that has the gravity already excluded.
MPL Gravity	Software	Reports the gravity vector in the device's coordinate system. Should be identical to the raw accelerometer values when the device is resting.
MPL Signification Motion	Software	A composite sensor that allows the device to fall asleep while the sensor is still working, which is very different from other sensors. This sensor is often used to listen for when the user starts to walk, run, bike, or something else.
MPL Step Detector	Hardware/ software	Fires a single event for every detected step the user takes while the sensor is active. Chapter 9 covered this sensor.
MPL Step Counter	Hardware/ software	Keeps track of the total number of steps the user has taken since the device was started. It resets the number of steps when the device is turned off or rebooted.
MPL Geomagnetic Rotation Vector	Software	Also called a magnetometer and is very similar to the rotation vector sensor. However, where the rotation vector uses a gyroscope, this uses the magnetometer. It reports the same set of values as the rotation vector.



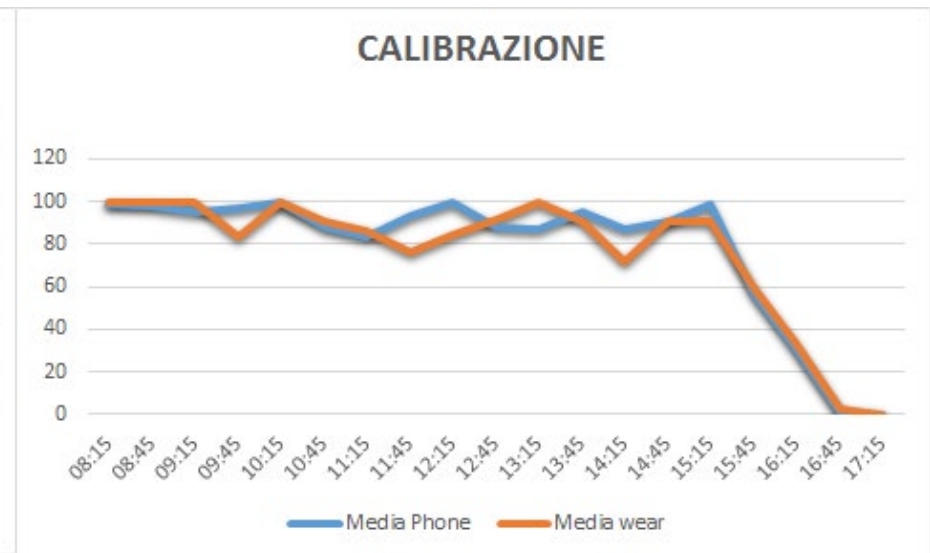
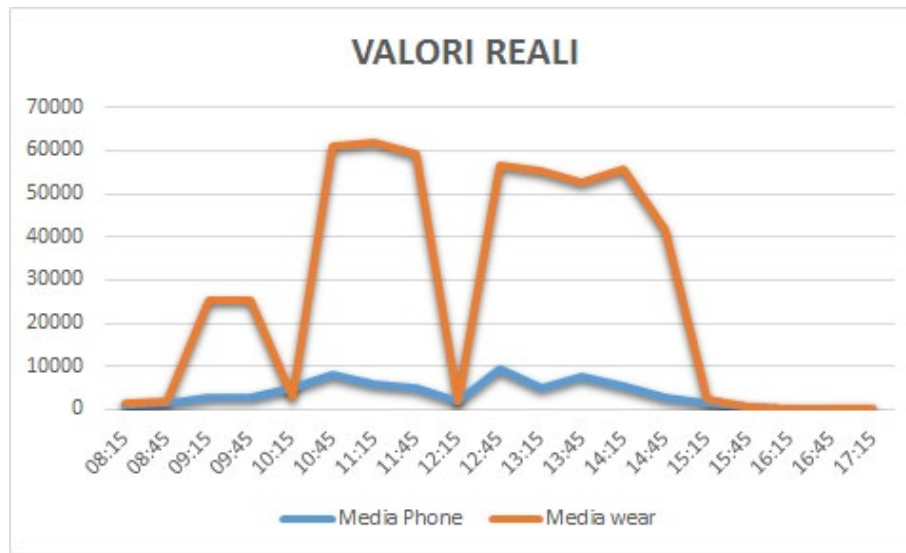
- During an experiment, a set of devices are used to collect data about the environment (light and sound)
  - Two Samsung Galaxy Nexus
  - A Samsung Galaxy S5
  - A Motorola Moto 360
  - A Sony Smartwatch 3
- Collected data are reported on a graph and ...  
*everything goes wrong!*

*Why?*

# Calibration



- Every sensor has different
  - Sensibility
  - Scale limit (max value)
- Need for a calibration phase



# An important note



- Everything can be hacked!
- Wearables are "*embedded computer*", therefore security is a very important issue



*Jack Barnaby*  
22 November 1977 – 25 July 2013

*Last but no Least!*

# Energy Consumption

Bluetooth communication between smartphone and smartwatch can soon drain the battery of both devices





- Books:
  - David Cuartielles Ruiz, Andreas CoranSSson. “Professional Android Wearables”. Wiley, 2015
  - A. Calvo. “Beginning Android Wearables”. Apress, 2015
- Some examples
  - <https://github.com/pro-android-wearables/courseware>
- Documentation
  - <https://developer.android.com/training/building-wearables.html>
- Misc
  - The invention of the first wearable computer
    - <https://www.cs.virginia.edu/~evans/thorp.pdf>
  - Jack Barnaby
    - [https://en.wikipedia.org/wiki/Barnaby\\_Jack](https://en.wikipedia.org/wiki/Barnaby_Jack)



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