

Innovation Week III: Wearable Technology

Yesoda Bhargava

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What is a wearable?

- small and compact electronic devices designed to be worn by a user.
- also referred to as **body-borne computers**.
- more powerful, more efficient, more compact.

How did it all happen?

Eyeglasses



1286

Now ubiquitous (and almost old fashioned, when you consider laser eye technology) the first eyeglasses will have been ground-breaking. Before the production of the convex lens, the short sighted had to find more ingenious ways to see; squinty Emperor Nero looked through an emerald in order to see at gladiator fights.

1510



Nuremberg Egg

The Nuremberg Egg was one of the first portable mechanical timekeeping devices. Cumbersome, inaccurate, and worn around the neck (like Flava Flav), these watches were a key status symbol in 16th century Europe.



ABACUS RING

Dating back to the early days of China's Qing dynasty, before the calculator watch, there was the abacus ring.

1600



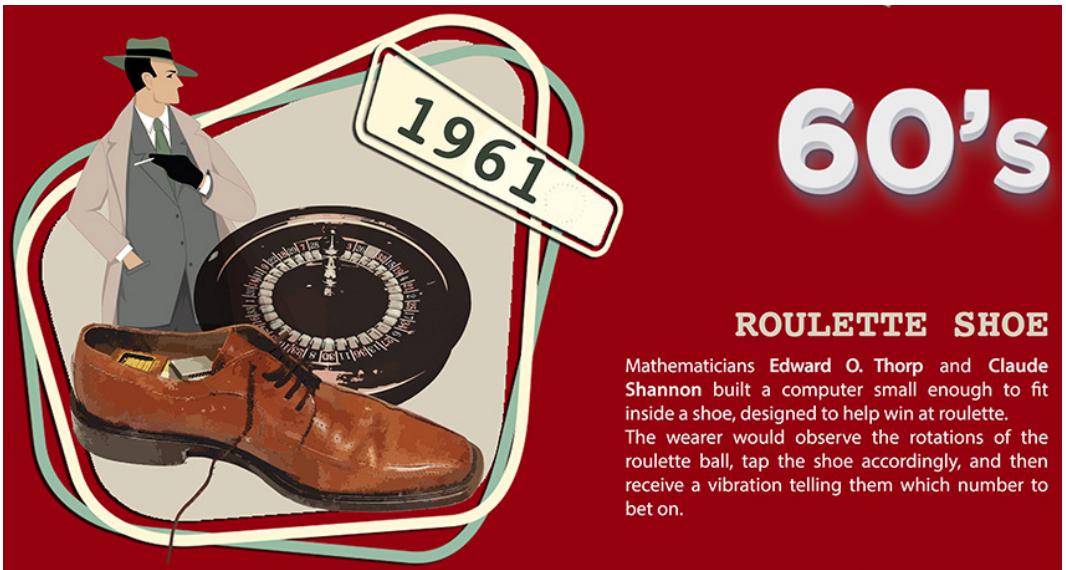
1900

1907

PIGEON CAMERA

Although at first a novelty, the **Pigeon Camera** found real use during the *First World War*, being used to capture aerial photographs behind enemy lines.

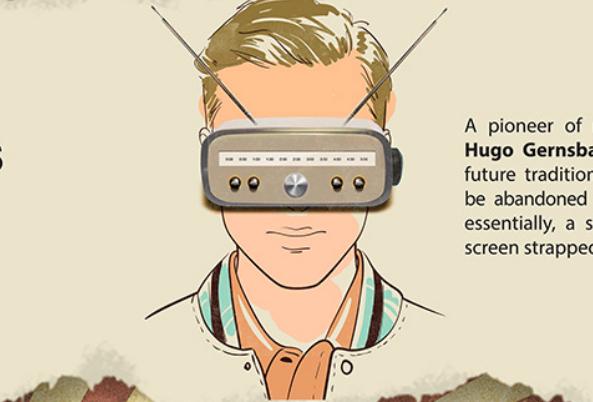




ROULETTE SHOE

Mathematicians Edward O. Thorp and Claude Shannon built a computer small enough to fit inside a shoe, designed to help win at roulette. The wearer would observe the rotations of the roulette ball, tap the shoe accordingly, and then receive a vibration telling them which number to bet on.

1963 TV GLASSES



A pioneer of modern science fiction, **Hugo Gernsback** thought that in the future traditional television sets would be abandoned in favour of TV glasses; essentially, a small portable television screen strapped to the face.

70's

1975

The **Pulsar Calculator Watch** was one of the first widespread modern bits of wearable tech. Models ranged from \$300 for a stainless steel version, to \$3950 for a solid gold model (sound familiar?).

1979

The first low cost portable stereo, the **Sony Walkman** changed how the world listens to music, and arguably halved unwanted public transport conversations.



80's



1981

SEIKO UC 2000 WRIST PC

Marketed as a portable PC, the UC 2000 let users tell the time, add up, and input up to 2kb of exciting data via a keyboard strapped to the arm. It wasn't exactly a smash hit.

1984

NELSONIC SPACE ATTACKER WATCH

Nelsonic made gaming portable with the Space Attacker Watch, with the two front buttons allowing wearers to play a basic space invaders style arcade game.

1989

PRIVATE EYE

A head mounted screen, hand held input device, 85mb hard drive and motorbike battery made up this device, one of the earlier attempts at a portable Google Glass style computer.

2000•

LEVI'S ICD+ JACKET

Levi's came into the new millennium with the ICD+ anorak. A conductive fabric harness allowed for a mobile phone, mp3 player, and headphones to be integrated within the jacket, with a built in button allowing wearers to switch between these.



2006•

Nike+

A collaboration between Nike and Apple, Nike+ was (and is) a fitness tracking kit. Via a shoe embedded tracker, they could view the time, distance, pace and calories covered during a workout on an iPod Nano screen.



2013•



• 2002

BLUETOOTH HEADSET

Using the then new Bluetooth technology, Nokia introduced the Bluetooth headset, allowing users to take calls hands free. So they could focus on juggling, or whatever.



• 2008

FITBIT CLASSIC

Much of the wearable tech of recent years has been fitness based, with the Fitbit wristband being one of the pioneers, allowing wearers to track steps taken, distance travelled, calories burned, activity intensity and sleep.



2014

ACTIVITY TRACKERS

Fitness and activity trackers have been some of the most accessible wearable tech items of recent years, with models allowing users to view steps taken, walking speed, heart rate, sleeping patterns, and even monitor UV ray exposure.

SOLAR POWERED JACKET

In late 2014 Tommy Hilfiger released a jacket with embedded solar panels, allowing users to charge their phone on the go.



APPLE WATCH

We've come a long way since the **Nuremberg Egg**, with the **Apple Watch** being one of the most anticipated wearable announcements of 2015. As well as texting, fitness tracking, TV control and ticket storage, the **Apple Watch** can also tell the time.



RINGLY

Ringly offers *an escape from your phone*, alerting wearers of notifications via a discrete series of vibrations and light displays. The theory is that users will only check their phone when alerted of something really important.

2015



QUELL

When strapped to the body, **Quell** recognises the signs of oncoming chronic pain, and acts to stimulate nerves and block pain signals to the brain.



bPAY

Wearers of **Barclay's bPay** can make contactless payments via a personalised wristband, removing both the hassle of remembering a pin and carrying a bank card.

2015-2016



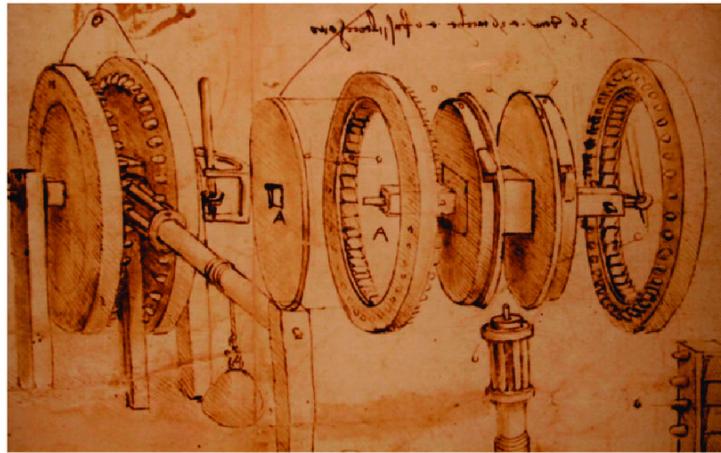
OCULUS RIFT

Via a motion sensing headset, headphones and built in display, this **virtual reality** tool lets users step inside games and other virtual worlds to experience these more vividly than before.

- What do you think led to innovations we just saw?
- What need could have been imagined?
- Pre-cursor to wearable technology?
- More on history at [History of Wearable Technology](#), [Brief History of Wearables](#)

Evolution of wearables into fitness

- History of pedometer dates back to sketches made by Leonardo da Vinci.
- He sketched the design for a gear-driven device with a pendulum arm that would swing back and forth with every walking leg motion and measure distance traveled.



- Abraham-Louis Perrelet, a Swiss inventor and Thomas Jefferson are few names associated with pedometer development.

Below is an excerpt from Padover's *The Complete Jefferson*, P. 969-970 and a letter from Thomas Jefferson to James Madison on May 3rd, 1788:

"I send your pedometer. To the loop at the bottom of it, you must sew a tape, and at the other end of the tape, a small hook . . . cut a little hole in the bottom of your left watch pocket, pass the hook and tape through it, and down between the breeches and drawers, and fix the hook on the edge of your knee band, an inch from the knee buckle; then hook the instrument itself by its swivel hook, on the upper edge of the watch pocket. Your tape being well adjusted in length, your double steps will be exactly counted by the instrument, the shortest hand pointing out the thousands, the flat hand the hundreds, and the long hand the tens and units . . ."

This was often called the **Tomish Meter**

Promotion of pedometer as fitness device

- In the 1960s Dr. Yoshiro Hatano, a professor at the Kyushu University of Health and Welfare, undertook some applied research into exercise and calories. [History of pedometer](#)
- Concerned about the rise in obesity in Japan and wanting to promote and reinforce daily activity as part of “good health,” Hatano began selling a device known as “Manpo-kei” – the 10,000 steps meter.

1921

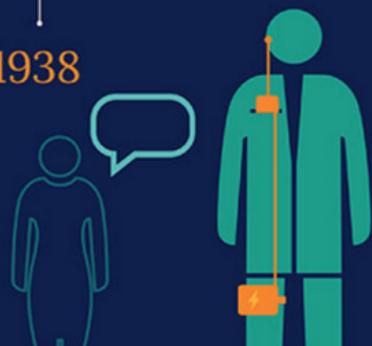
GSR - The polygraph



Invented before World War II, the 'lie detector' was the first machine to include sensors to measure galvanic skin response (GSR), pulse rate and blood pressure to sniff out the telltale physiological indicators of fibbing to the police. The technology is now commonplace on fitness trackers.³

Wearable hearing aid 1938

Back in 1938, Chicago electronics manufacturer Aurex Corp. developed the first wearable hearing aid, marking one of the earliest steps into what has become the fast-growing medical device wearables industry.⁴



Making fitness tracking more accessible

Nike&iPod launched a wireless system that allows Nike+ footwear to talk with an iPod Nano to connect you to the ultimate personal running and workout experience.⁶



2003 C-Series



The Vitatron C-Series was the world's first fully digital pacemaker. With the device, clinicians can download patient information in just 18 seconds.⁵



2009

The W200

The W200 Wearable Computer was released by Glacier Computers, designed mainly for those in emergency response situations who needed to access large amounts of information while remaining mostly hands-free. The device is water-resistant and weighs 10 ounces.⁷

Philips Lifeline 2010

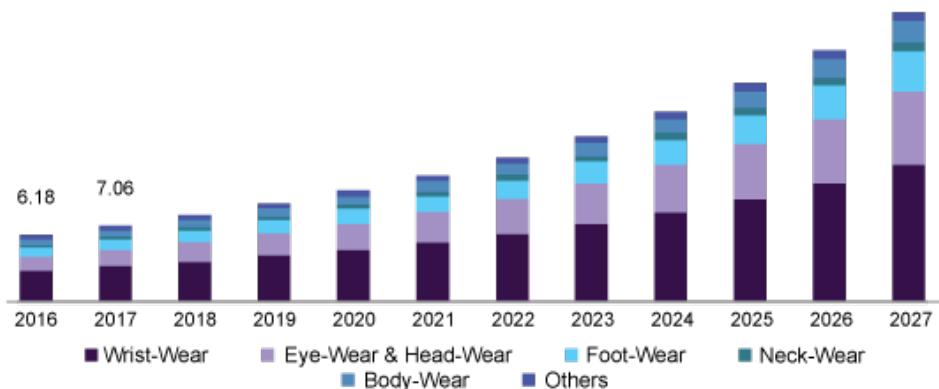
Philips Lifeline introduced the AutoAlert automatic fall detection technology. By leveraging the latest wireless technology, HomeSafe and GoSafe systems allow seniors to call for help from any place in their homes or practically anywhere they travel.⁸



Current Wearables Market



U.S. wearable technology market size, by product, 2016 - 2027 (USD Billion)

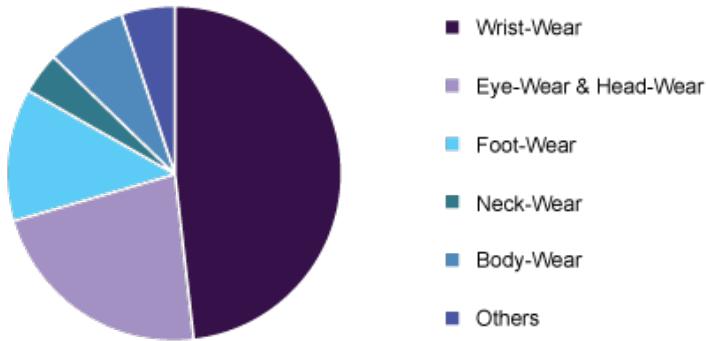


Source: www.grandviewresearch.com

Current Wearables Market



Global wearable technology market share, by application, 2019 (%)



Source: www.grandviewresearch.com

WEARABLE TECHNOLOGY MARKET SIZE, 2016= USD XX BILLION



Wearable Market

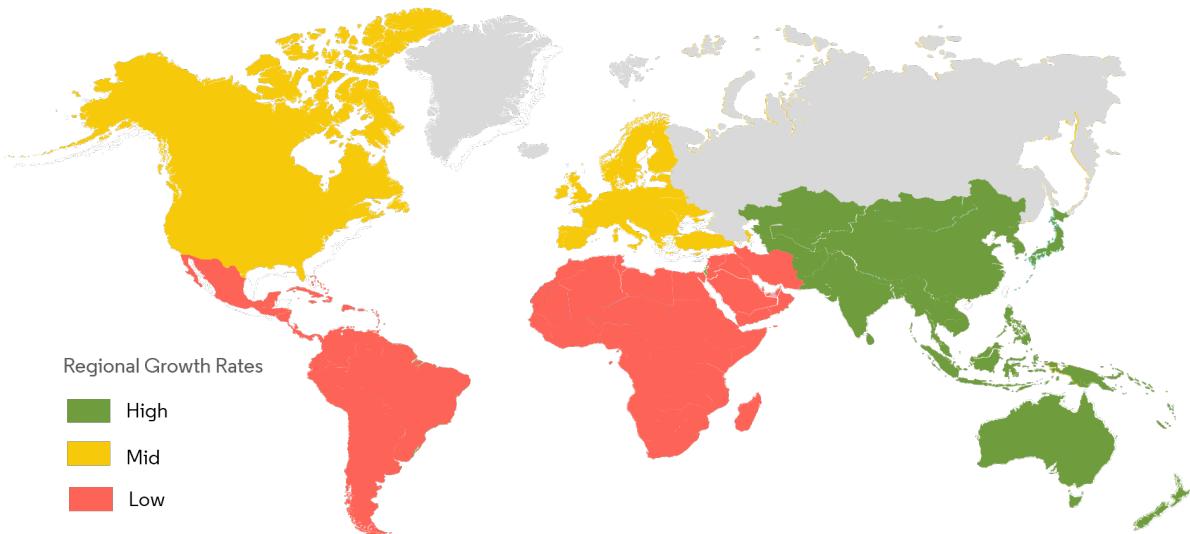
- The global wearable healthcare devices market is projected to reach USD 46.6 billion by 2025 from USD 18.4 billion in 2020, at a CAGR (compound annual growth rate) of 20.5% from 2020 to 2025.
- Emerging economies such as India, China, and Brazil are expected to provide a wide range of opportunities for players in the industry.
- Increasing adoption of AI and 5G, and the growing awareness and preference for home healthcare will also boost the growth of this market.
- Asia-Pacific is expected to witness the highest growth in the smart wearable market during the forecast period.
- In China, the wearables market has taken on a different shape fuelled partly by the purchases of growing affluent consumers.

GLOBAL WEARABLE TECHNOLOGY MARKET BY REGION



North America was the highest contributor to the global wearable technology market with \$8,456 million in 2015 and is estimated to reach \$24,961 million by 2022 growing at a CAGR of 16.6% from 2016 to 2022.

Smart Wearable Market - Growth Rate by Region (2019-2024)



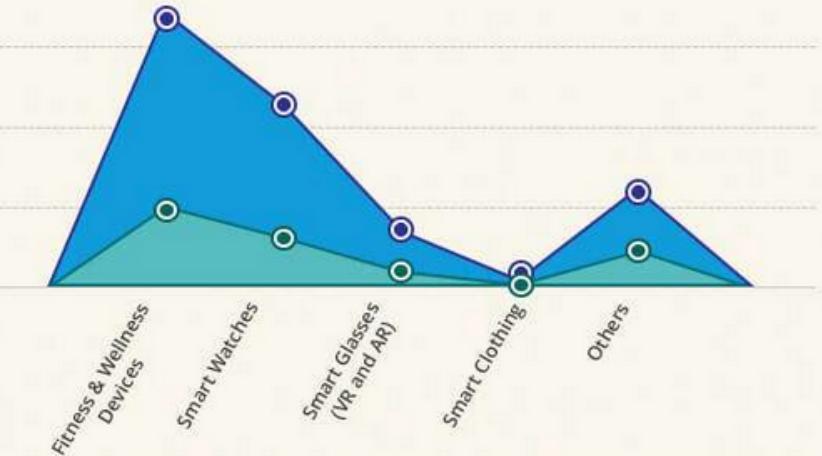
Source: Mordor Intelligence



GLOBAL WEARABLE TECHNOLOGY MARKET BY DEVICES

2016

2022



FITNESS AND WELLNESS DEVICES was the highest revenue generating segment and is estimated grow at a CAGR of 15.6% from 2016 to 2022

Wearable Technology Market Key Segments

- By Devices:

- Smart watches
- Smart glasses
- Fitness and wellness devices
- Smart clothing
- Others (Earphones, body monitors, and wearable cameras)

- By Product Type:

- Wrist wear
- Eye wear
- Hear-ables
- Body wear
- Neck wear

- By Application:

- Lifestyle
- Healthcare
- Consumer applications
- Defense
- Fitness and sports
- Enterprise and industrial

Ideas to ponder

- We must appreciate the process by which a technology grows.
- Try to identify what triggers origination of ideas and evolution of the solutions.
- What is the link between steps and fitness?
- How well do these devices actually track steps?

Key Market Players

- Apple Inc.
- Fitbit, Inc.
- Garmin Ltd.
- Adidas AG.
- Nike Inc.
- Samsung Electronics Co., Ltd.
- Sony Corporation
- Huawei Technologies Co., Ltd.
- LG Electronics Inc.
- Motorola Solutions Inc.

If you were to suggest an idea in the domain

- Start using wearable devices or fitness apps in your mobiles.
- Observe what it does and the kind of trend it is showing.
- How relevant it is for you? What is missing?
- What would you suggest to improve?
- How is it relevant to all age groups of people?
- **Do a study of all fitness wearables in the market, identify their features list and critique on the relevance of various features and suggest improvement areas.**
- Read about the technology on research papers.
- Read about the most prevalent problems being solved using wearables.

Suggested Readings

- Wearable Health Technology and Electronic Health Record Integration: Scoping Review and Future Directions
- Wearable Technology and How This Can Be Implemented into Clinical Practice
- Evolution of Wearable Devices with Real-Time Disease Monitoring for Personalized Healthcare
- Wearable Health Devices—Vital Sign Monitoring, Systems and Technologies
- Review on Wearable Technology Sensors Used in Consumer Sport Applications
- Monitoring Physical Activity with Wearable Technologies
- The Rise of Consumer Health Wearables: Promises and Barriers
- Data Analytics and Applications of the Wearable Sensors in Healthcare: An Overview
- The utility of wearable fitness trackers and implications for increased engagement: An exploratory, mixed methods observational study

Next Lecture: **Geriatric Care Innovation Services**

For any queries write to me at yesodabhangava@iiitp.ac.in. Thank you.