

IoT Device Fingerprint

What are we giving out when using Smart Phones

Asst. Ekarat Rattagan, Ph.D.

Outline

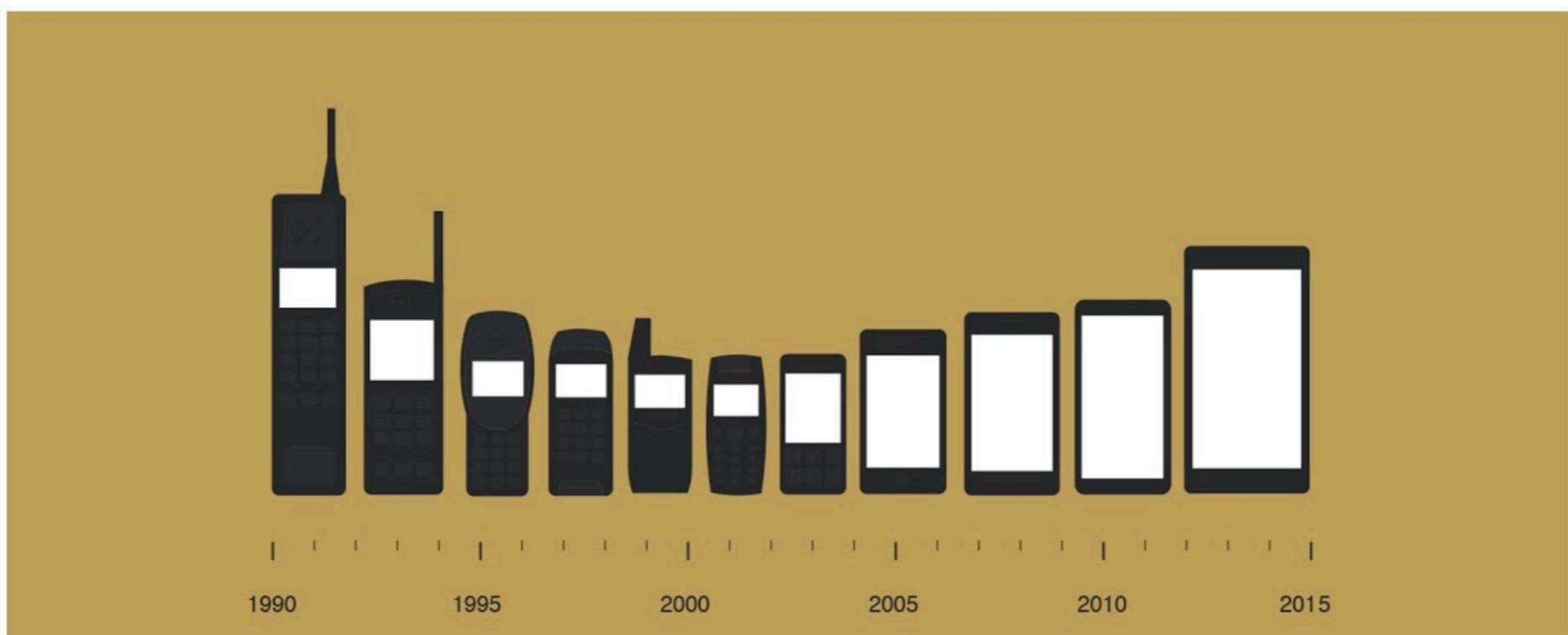
- Introduction
- Sensors
- What are we giving out?
- How to obtain mobile data?
- Future of IoT Device Fingerprint

Introduction

Introduction

PlacPac
Media

History Of Smartphone



<https://i.ytimg.com/vi/MugomReT2wU/maxresdefault.jpg>

Introduction



Sensors

Sensors Everywhere

The average smartphone has at least 10 sensors.
Here are the most common.

Camera

What would you do without your selfies?

Pedometer

More and more phones are including a fitness element. Experts recommend 10,000 steps a day.

Light Sensor

Have you ever turned your phone on in the dark and had it been too bright? Your light sensor may have been malfunctioning.

Thermometer

If you've ever left your phone out in the sun you've most likely seen it turn off due to heat. The thermometer is useful to monitor internal operating temperature.

Fingerprint Sensor

The new fingerprint sensor adds an extra layer of security to your phone.

Proximity Sensor

This is what keeps you from accidentally pressing buttons with your cheek during calls!

Magnetometer

The magnetometer measures the strength of the magnetic field around the device to determine what direction it is moving.

Accelerometer

Have you ever wondered how your phone knows which way you are holding it to display vertically vs. horizontally? The acceleromerter is the answer!

Gyroscope

If you like taking non-blurry photos you have the gyroscope to thank. It helps to correct for camera shake.



Microphone

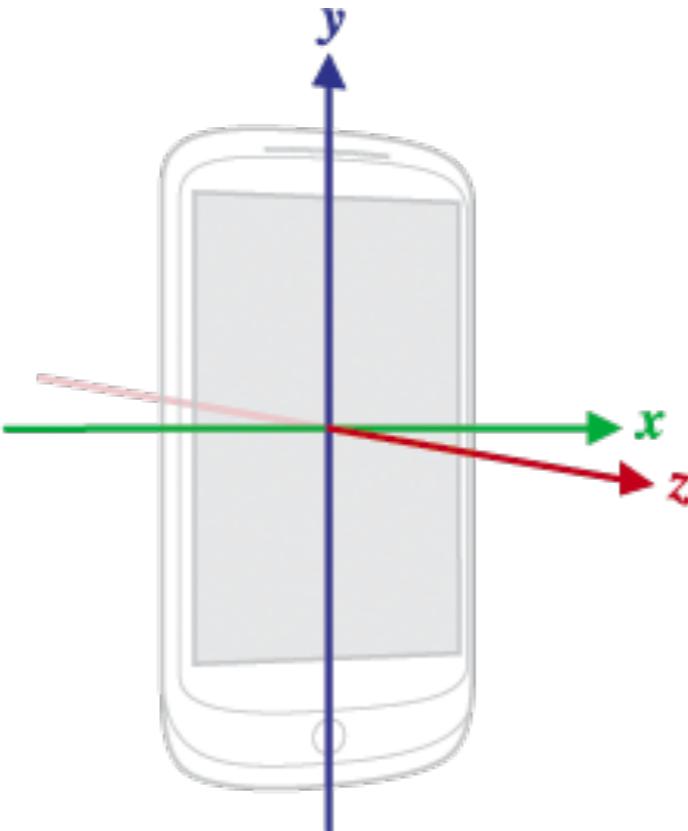
The oldest sensor on any phone. Microphones make it possible for others to hear what you are saying.

Sensors

- 1. Motion Sensors**
- 2. Position Sensors**
- 3. Environmental Sensors**

1. Motion sensors

These sensors measure acceleration forces and rotational forces along three axes. This category includes *accelerometers*, *gravity sensors*, *gyroscopes*, and *rotational vector sensors* [1].



1. Motion Sensors

- Accelerometers: Motion detection (shake, tilt, etc.).

Position	X	Y	Z
UP:	0	9.81m/s ²	0
LEFT:	9.81m/s ²	0	0
DOWN:	0	-9.81m/s ²	0
RIGHT:	-9.81m/s ²	0	0
FRONT UP:	0	0	9.81m/s ²
BACK UP:	0	0	-9.81m/s ²

1. Motion Sensors

- Gyroscopes: measure the rate of rotation around an axis. When the device is not rotating, the sensor values will be zeroes.

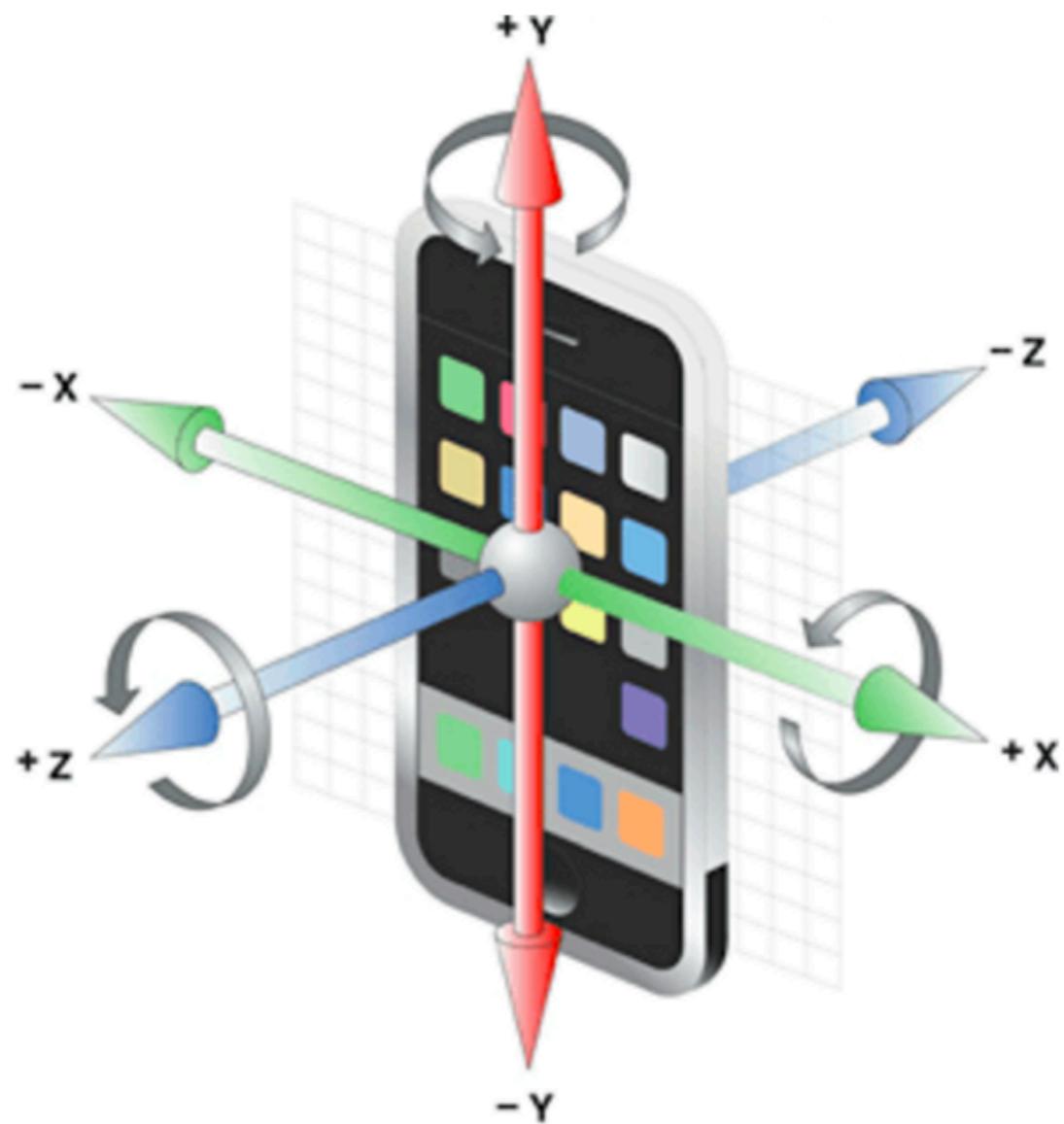
- Pitch (around x)
- Roll (around y)
- Azimuth (around z)



1. Motion Sensors



Accelerometer



Gyroscope

https://miro.medium.com/max/1400/1*FTmm7Bt9RFWgBshys1fWNA.png

2. Position sensors

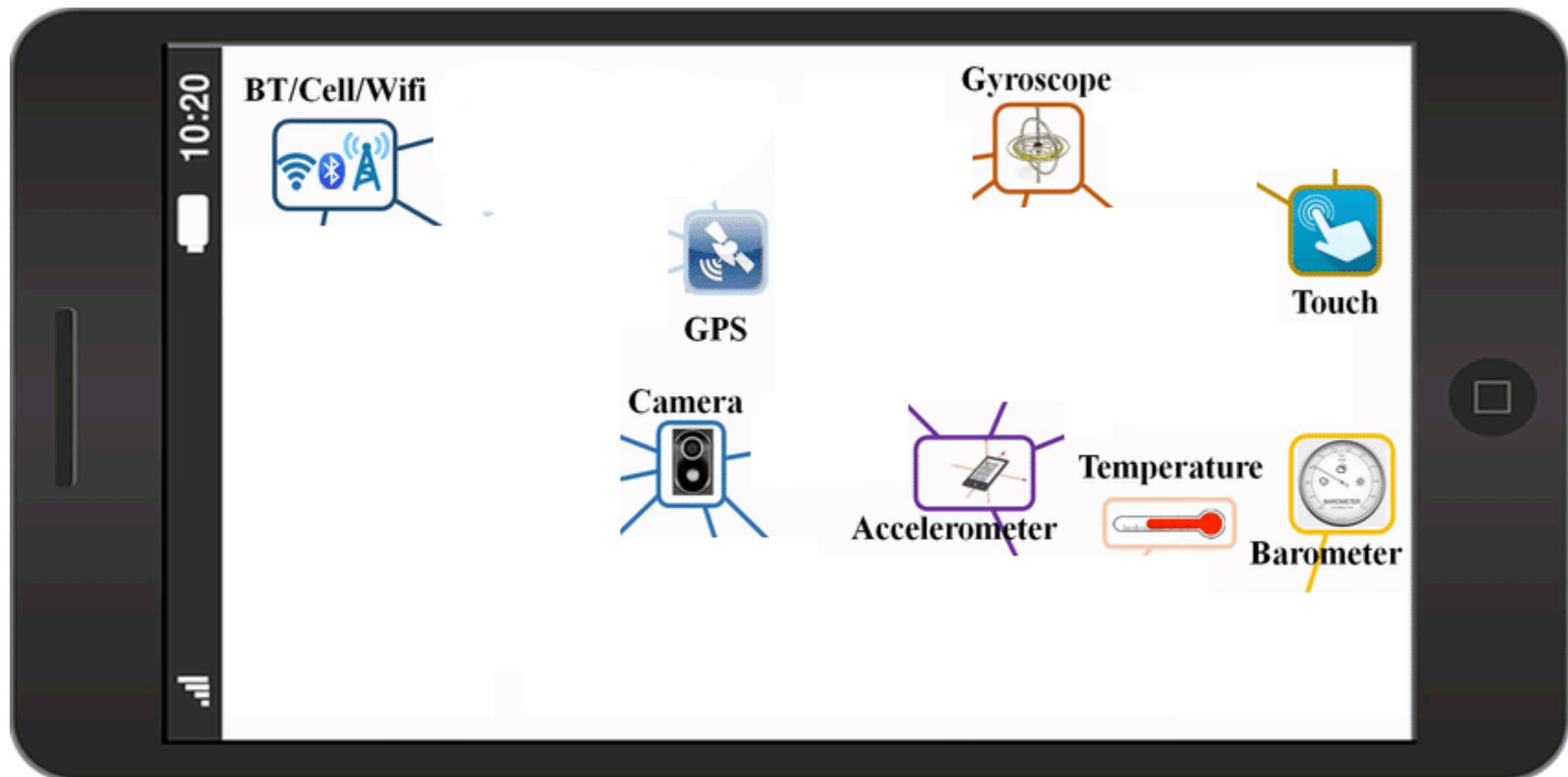
These sensors measure the physical position of a device. This category includes *orientation sensors* and *magnetometers* [1].

- Outdoor location: GPS
- Indoor location: Bluetooth Low Energy (BLE)

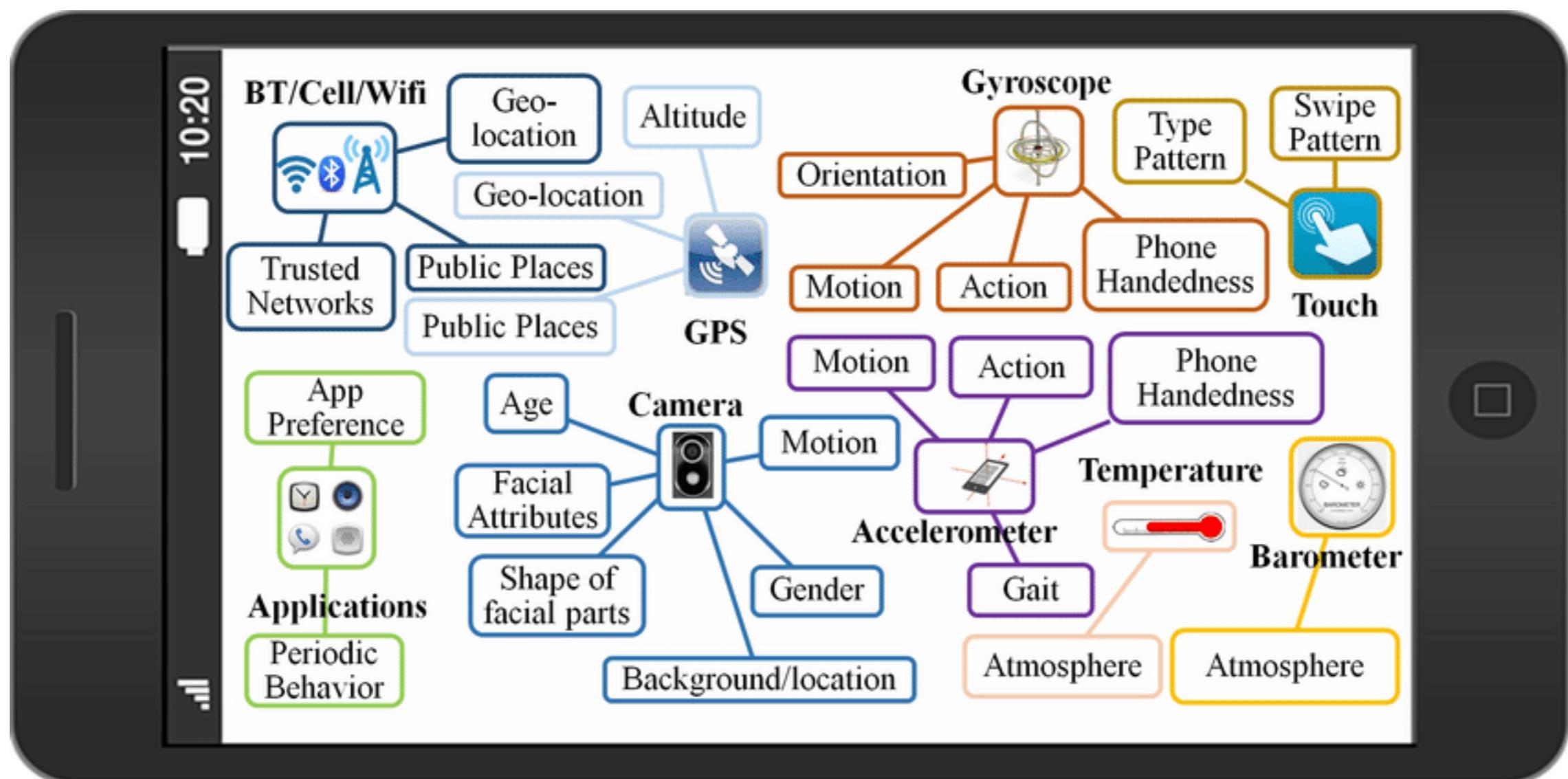
3. Environmental Sensors

- These sensors measure various environmental parameters, such as
 - Ambient air temperature
 - pressure
 - Illumination
 - Humidity
 - etc.

Sensors



Sensors



**What are we giving
out ?**

1. Activity classification

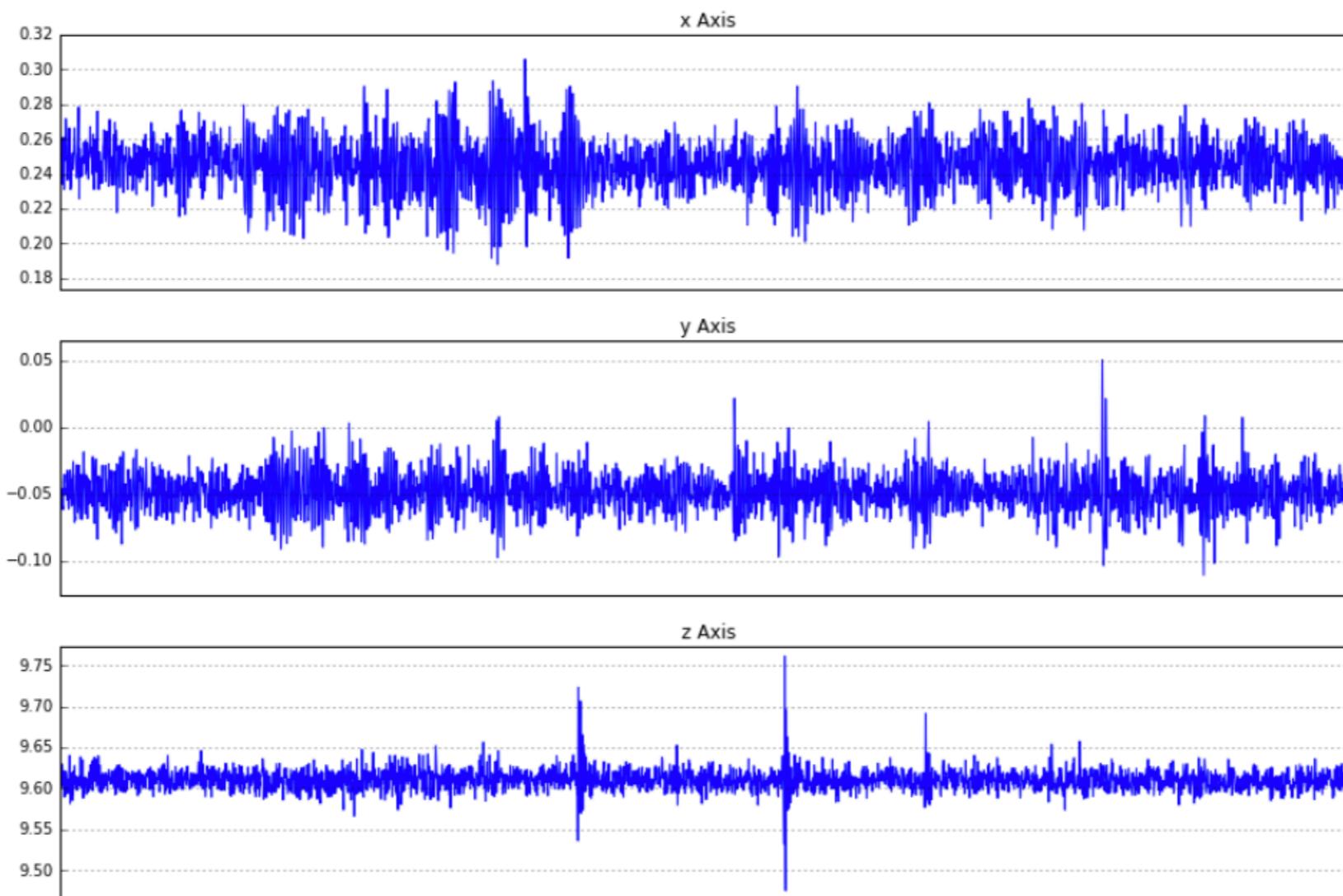
- What are smartphone users acting now?
 - Standing
 - Walk
 - Run
 - Stairs

1. Activity classification

- What are smartphone users acting now?
 - Standing
 - Walk
 - Run
 - Stairs
- Accelerometer sensor

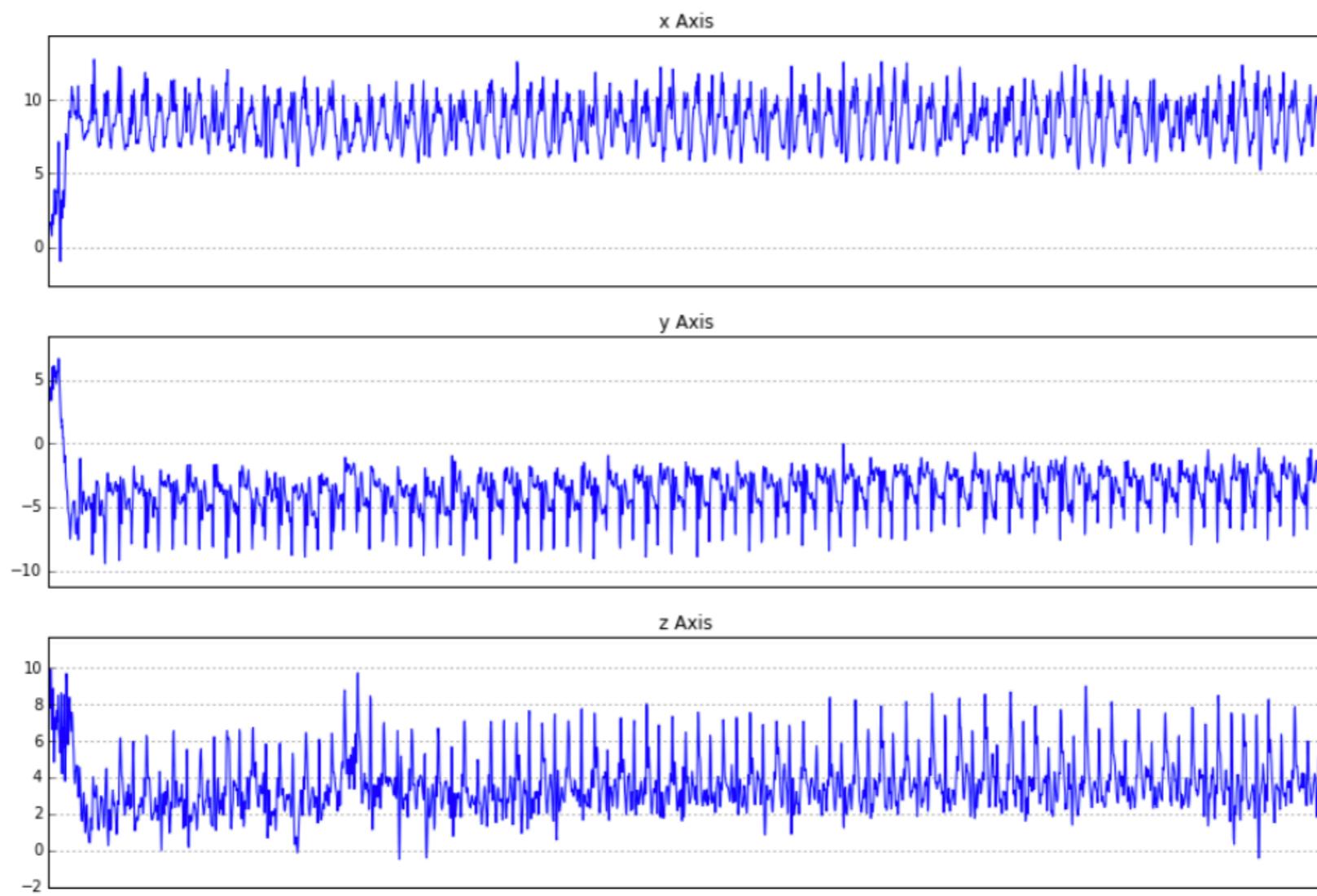
1. Activity classification

Raw: Standing



1. Activity classification

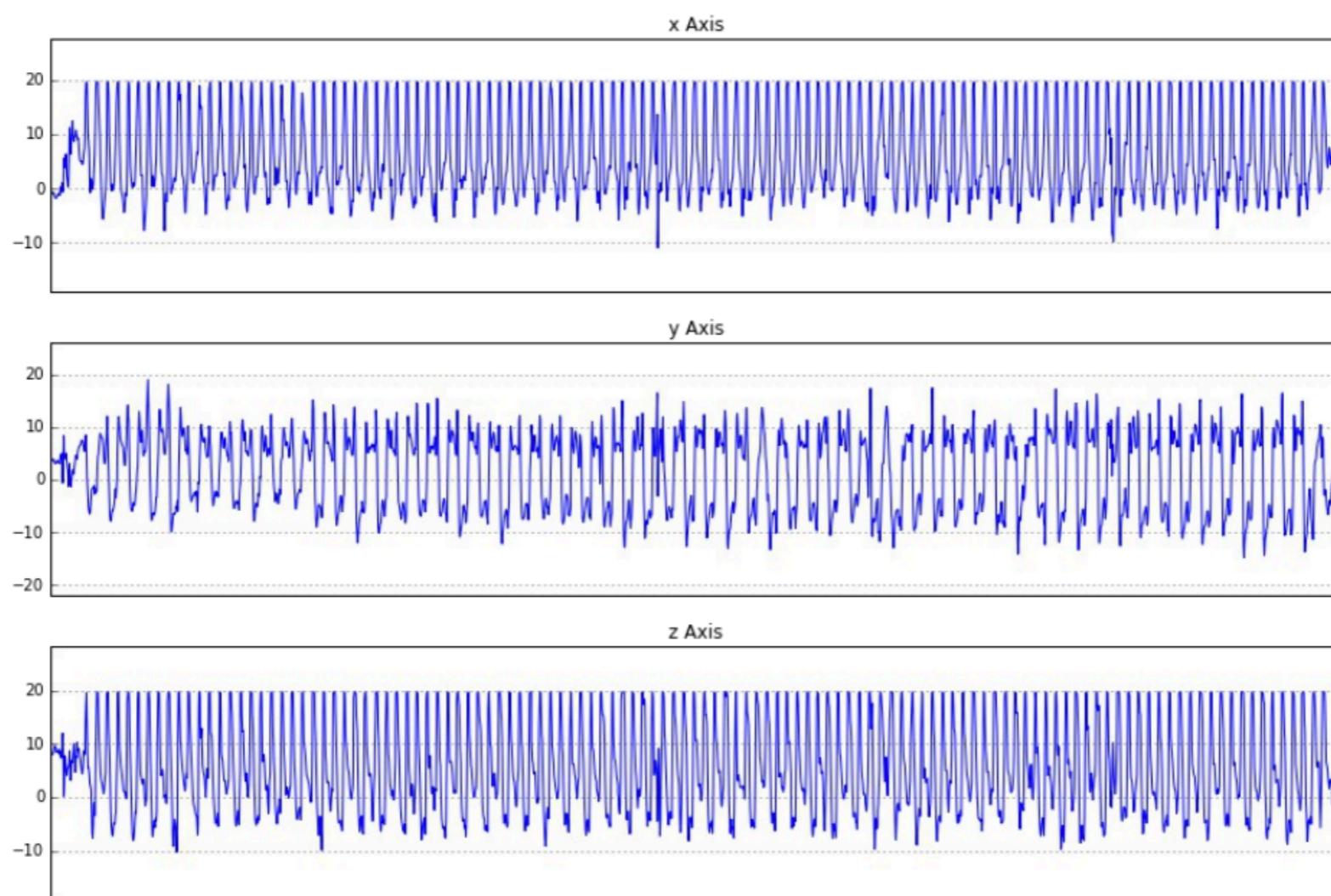
Raw: Walk



Ref: https://github.com/nlathia/pydata_2016/blob/master/Talk/Presentation.pdf

1. Activity classification

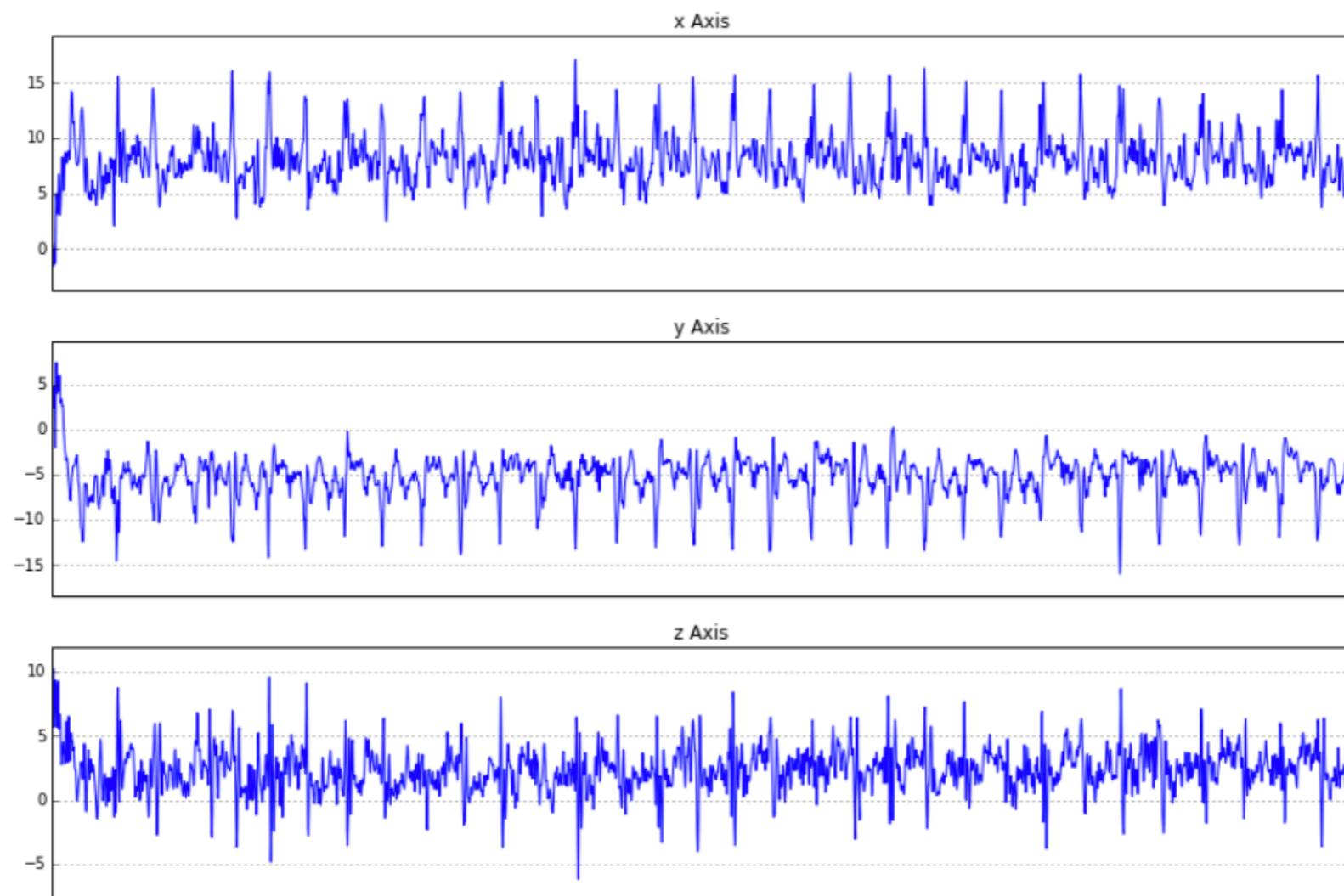
Raw: Run



Ref: https://github.com/nlathia/pydata_2016/blob/master/Talk/Presentation.pdf

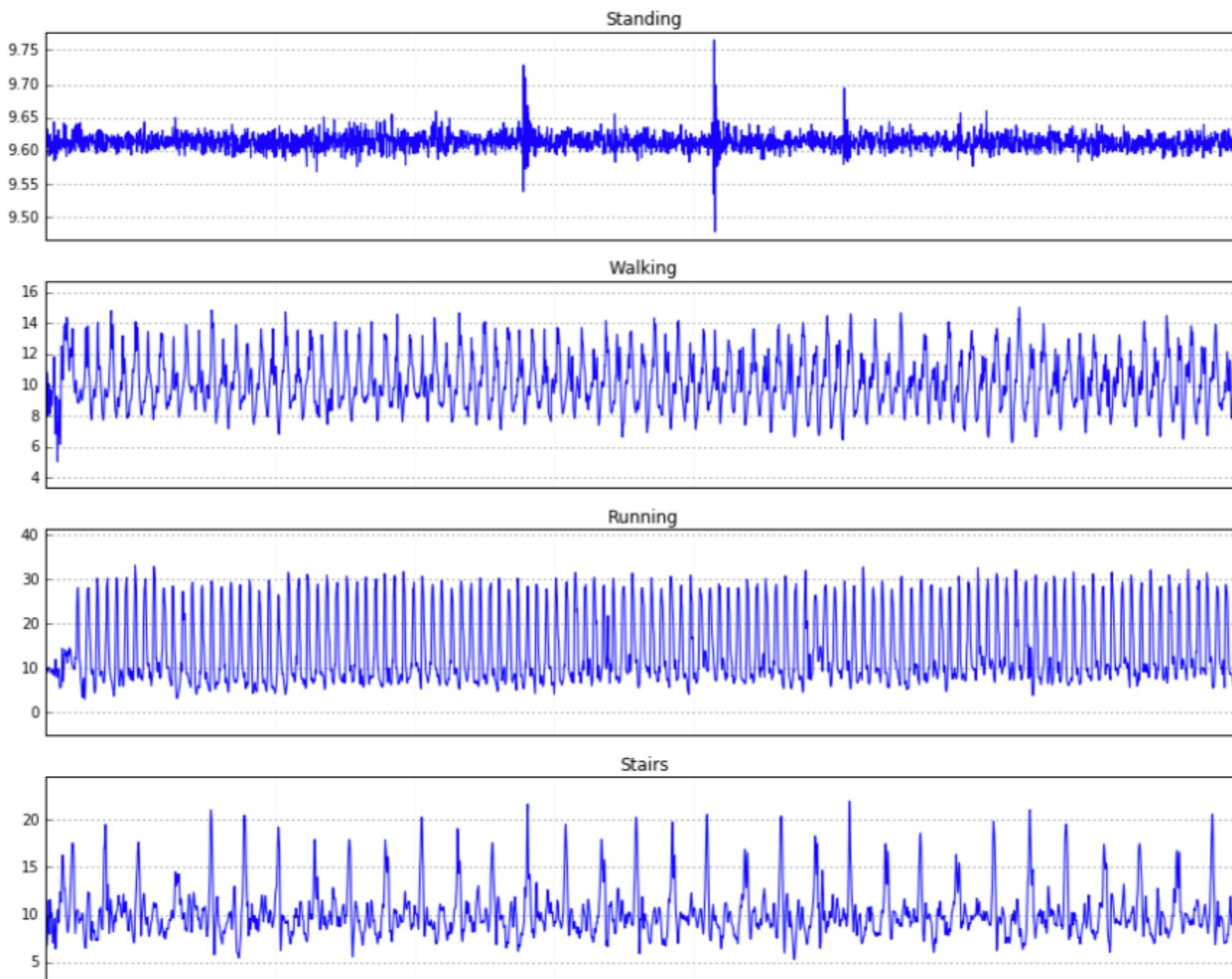
1. Activity classification

Raw: Stairs



Ref: https://github.com/nlathia/pydata_2016/blob/master/Talk/Presentation.pdf

1. Activity classification



Ref: https://github.com/nlathia/pydata_2016/blob/master/Talk/Presentation.pdf

2. Health data

- Cardiac monitors



<https://physicsworld.com/a/smартphone-app-tracks-heart-condition-at-home/>

2. Health data

- Glucose monitors



The simple-to-use personalized smart meter automatically logs & tracks blood sugar levels, shows you how sugar levels change and provides actionable insights and alerts. It plugs conveniently into your smart mobile device so you can view and share results wherever you are.

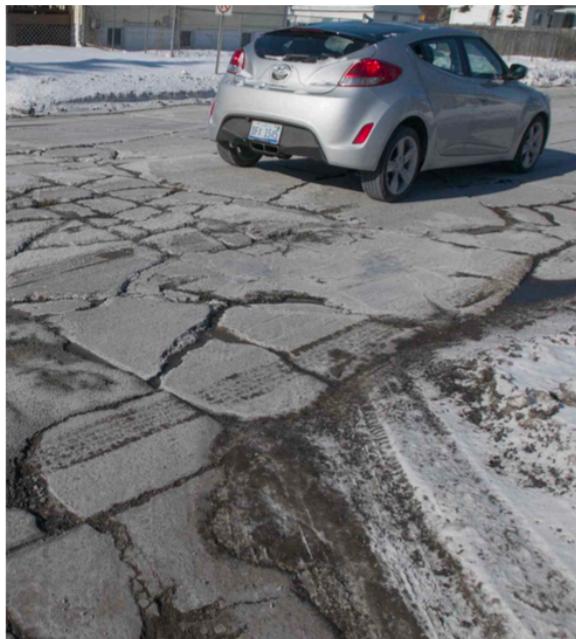
<https://mydario.co.uk/smart-meter/>

2. Health data

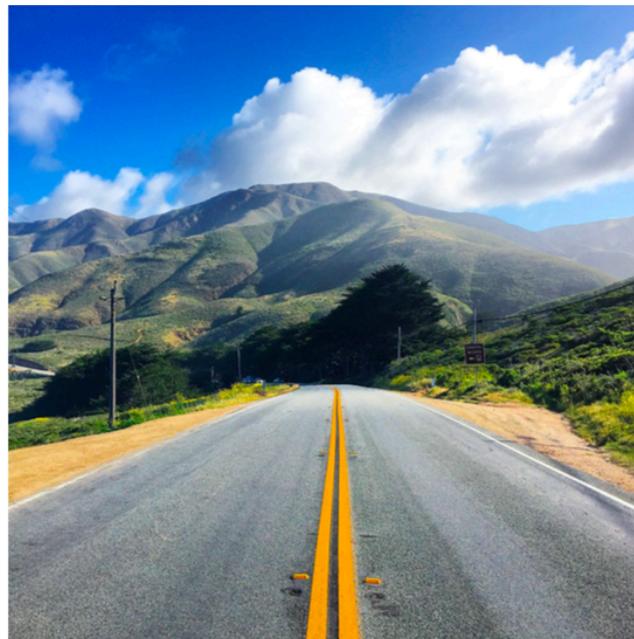
- Blood pressure monitors



3. Road quality detection



Bad road



Good road



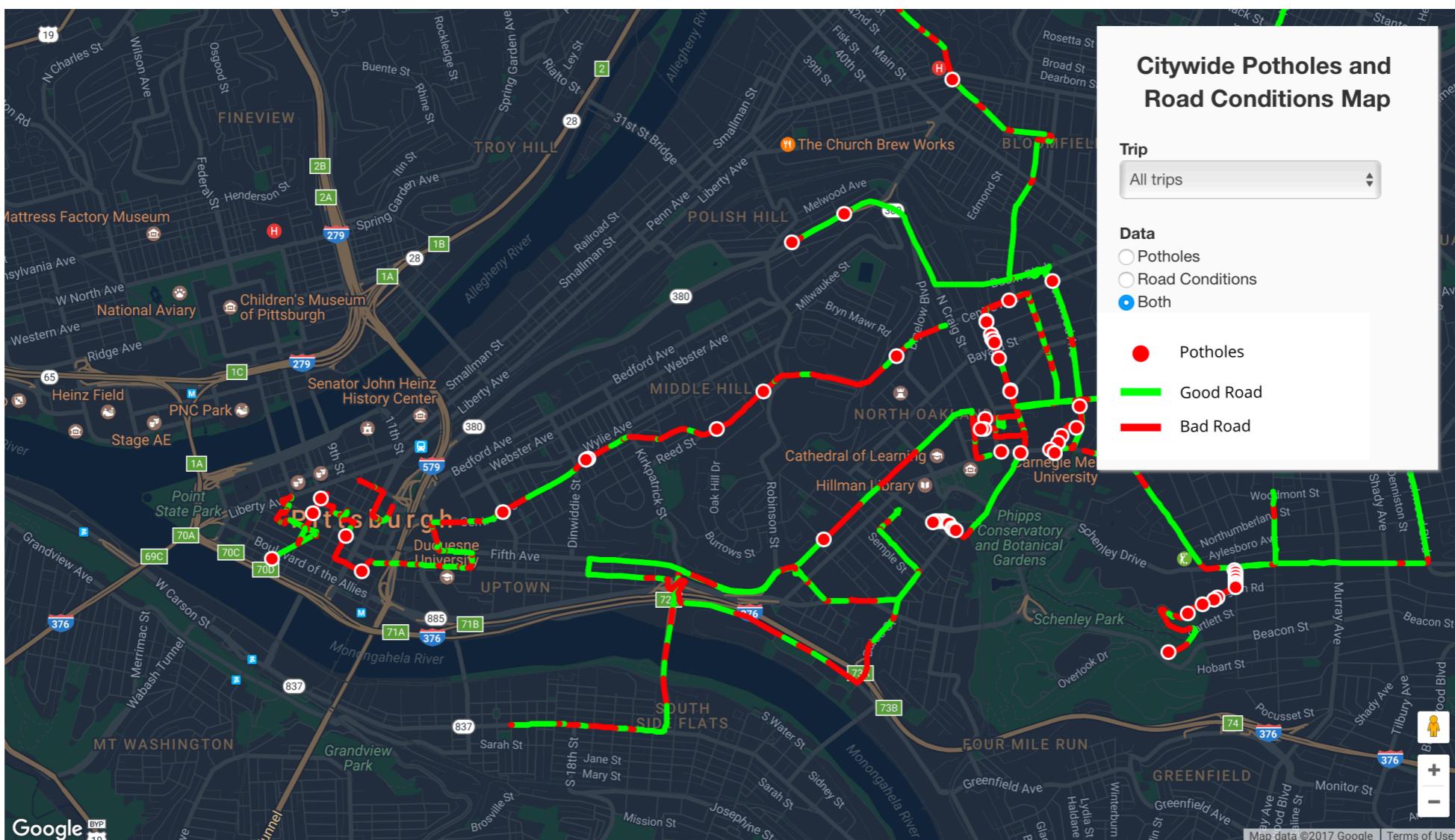
Pothole!

Problem 1: Road condition classification

Problem 2: Pothole detection

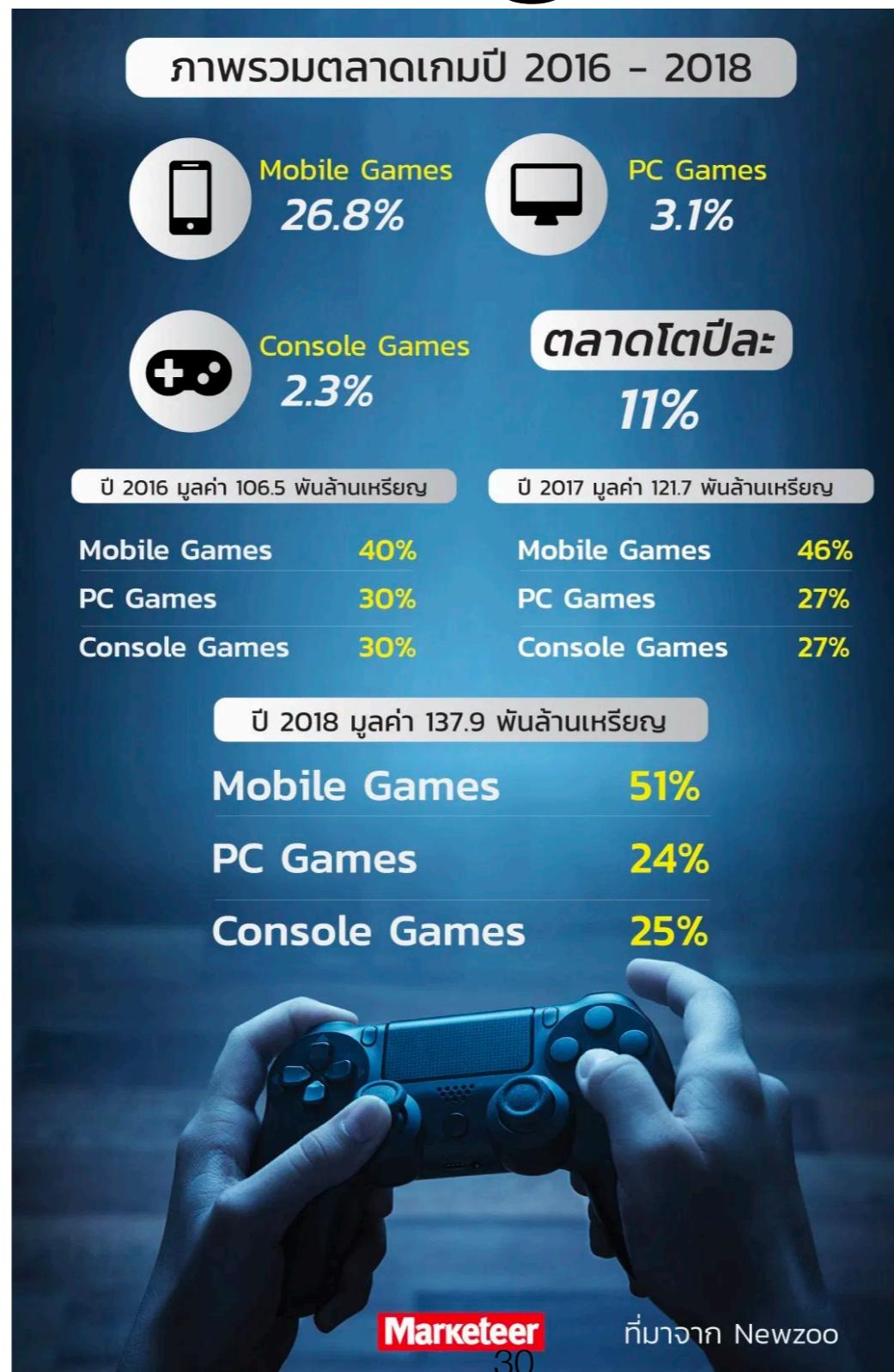
<https://medium.com/@percepsense/intelligent-pothole-detection-879ef635dd38>

3. Road quality detection

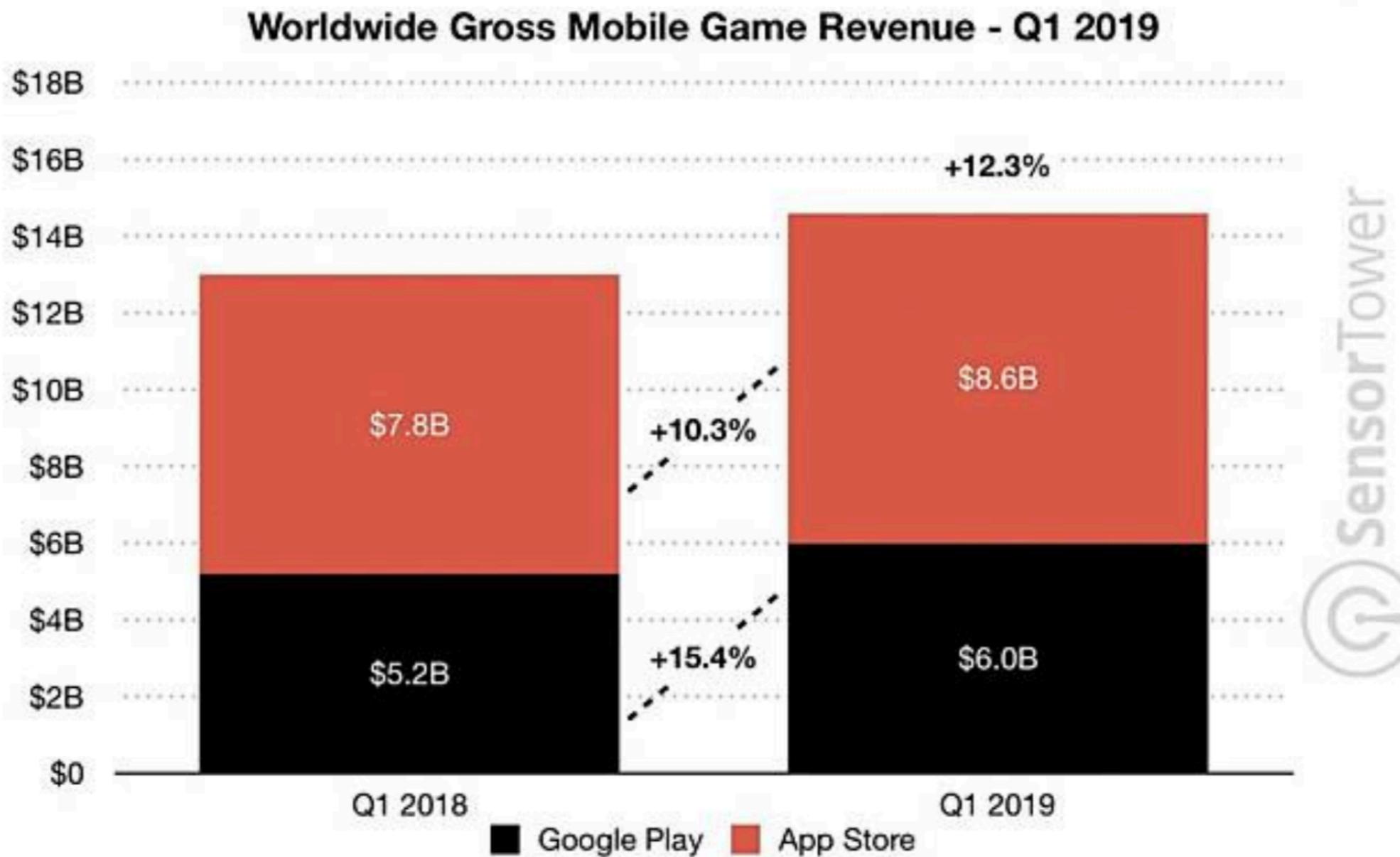


<https://medium.com/@percepsense/intelligent-pothole-detection-879ef635dd38>

4. Mobile game data



4. Mobile game data



SensorTower Data That Drives App Growth

sensortower.com ↗

4. Mobile game data

Top Mobile Games for Q1 2019 - App Store and Google Play



Revenue			Downloads		
#	Game	Publisher	#	Game	Publisher
1	Honor of Kings	Tencent	1	Color Bump 3D	101 Digital
2	Fate/Grand Order	Sony Aniplex	2	PUBG Mobile	Tencent
3	Monster Strike	Mixi	3	Garena Free Fire	Garena
4	Candy Crush Saga	King	4	Subway Surfers	Kiloo
5	Lineage M	NCSOFT	5	My Talking Tom 2	Outfit7
6	DBZ Dokkan Battle	Bandai Namco	6	Paper.io 2	Voodoo
7	Pokémon GO	Niantic	7	Helix Jump	Voodoo
8	Fantasy Westward Journey	NetEase	8	Brawl Stars	Supercell
9	Puzzle & Dragons	GungHo	9	Happy Glass	Lion Studios
10	PUBG Mobile	Tencent	10	Sniper 3D	TFG Co.

Does not include downloads or revenue from third-party Android stores in China.



Sensor Tower Data That Drives App Growth

sensortower.com

4. Mobile game data

1. How to understand which features of the game are good?
2. How to calculate and measure what is convincing users to play and pay and what's not?
3. If your users don't know how to make some game moves or they are stuck on a particular level of your game, how this information could be delivered to you developers in a clear and comprehensive way?
4. How can gameplay time be properly measured if the app is running on the background?

Answers to those questions are hidden in huge amounts of data you are collecting on your users and gamers. Some deeper data analysis can perform much more sophisticated queries on demand.

<https://addepto.com/benefits-big-data-analytics-mobile-gaming-industry/>

How to obtain mobile data?

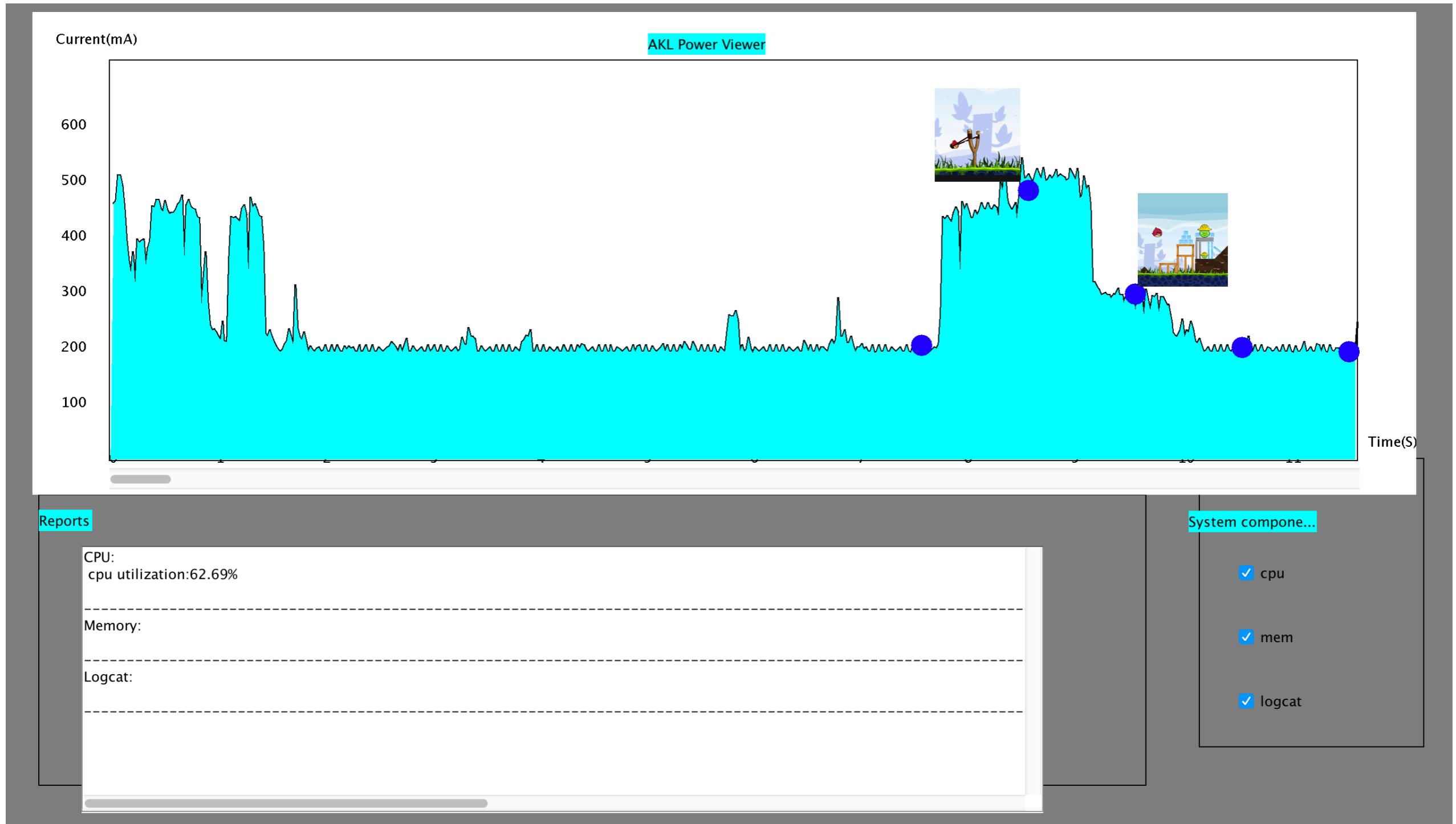
Methods

- **Create your own tools**
- **Commercial tools**

Create your own tools

- Require technical skills
- Flexible— You can get whatever you want

My own tool



Commercial tools

- Appsee



https://www.youtube.com/watch?v=aRN_XrxNCNE&t=332s

Future IoT Device Fingerprint

**Feasibility to make a technology
presented in
“Dejavu”
movie**

**THE FOLLOWING PREVIEW HAS BEEN APPROVED FOR
ALL AUDIENCES
BY THE MOTION PICTURE ASSOCIATION OF AMERICA**

www.filmratings.com

www.mpaa.org

**Feasibility to make a technology
as presented in
“Detroit: Become Human”
Video game**





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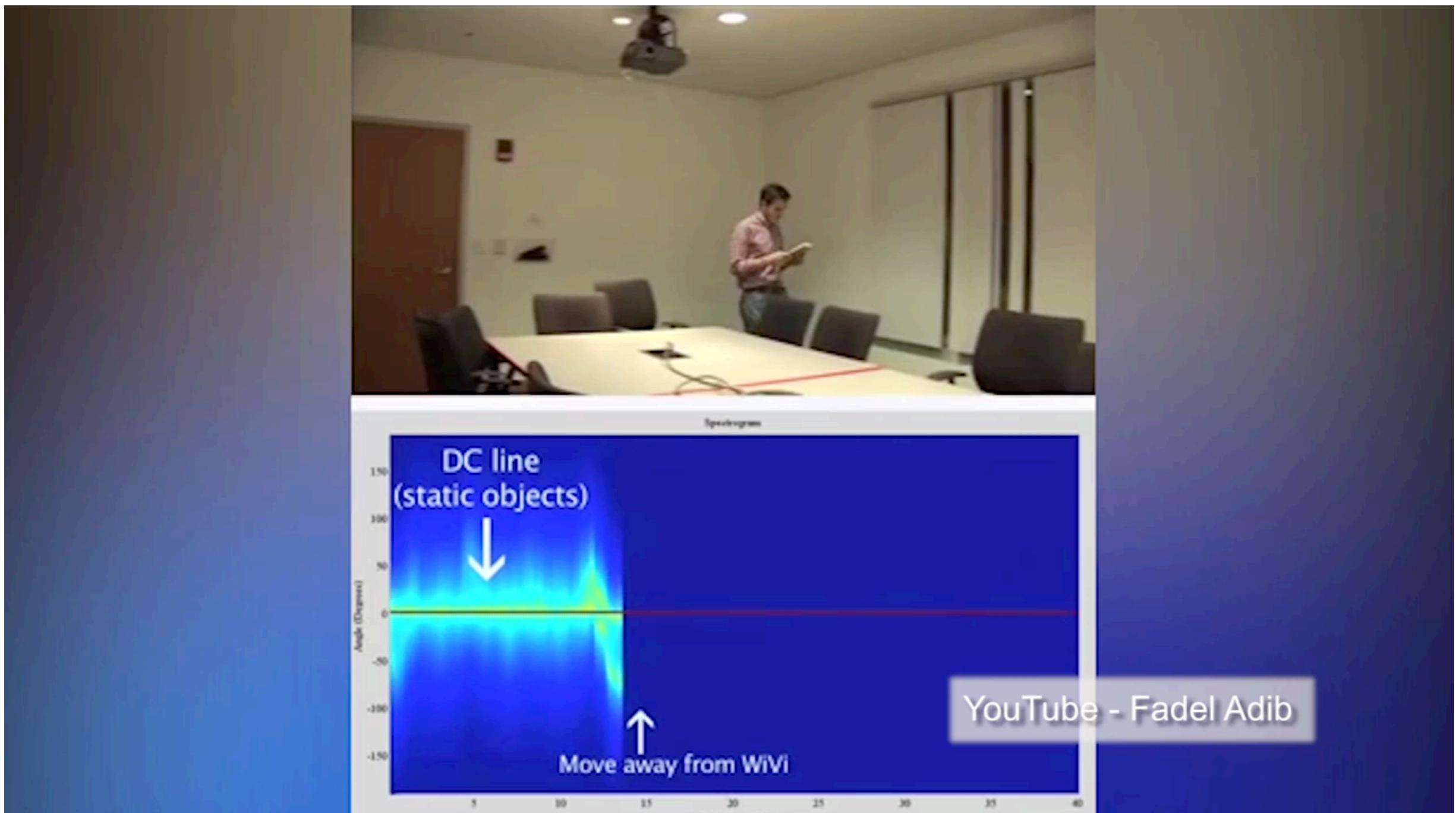
PI CORE/DUAL

Dina Katabi

Professor

Wi-Vi: See Through Walls with Wi-Fi Signals

Fadel Adib Dina Katabi



Wi-Vi: See Through Walls with Wi-Fi Signals

Fadel Adib Dina Katabi

<https://youtu.be/aKsxHS5vptM?t=651>

- **End**