Mobile Computing

COMP5216/COMP4216

Week 05

Semester 2, 2023

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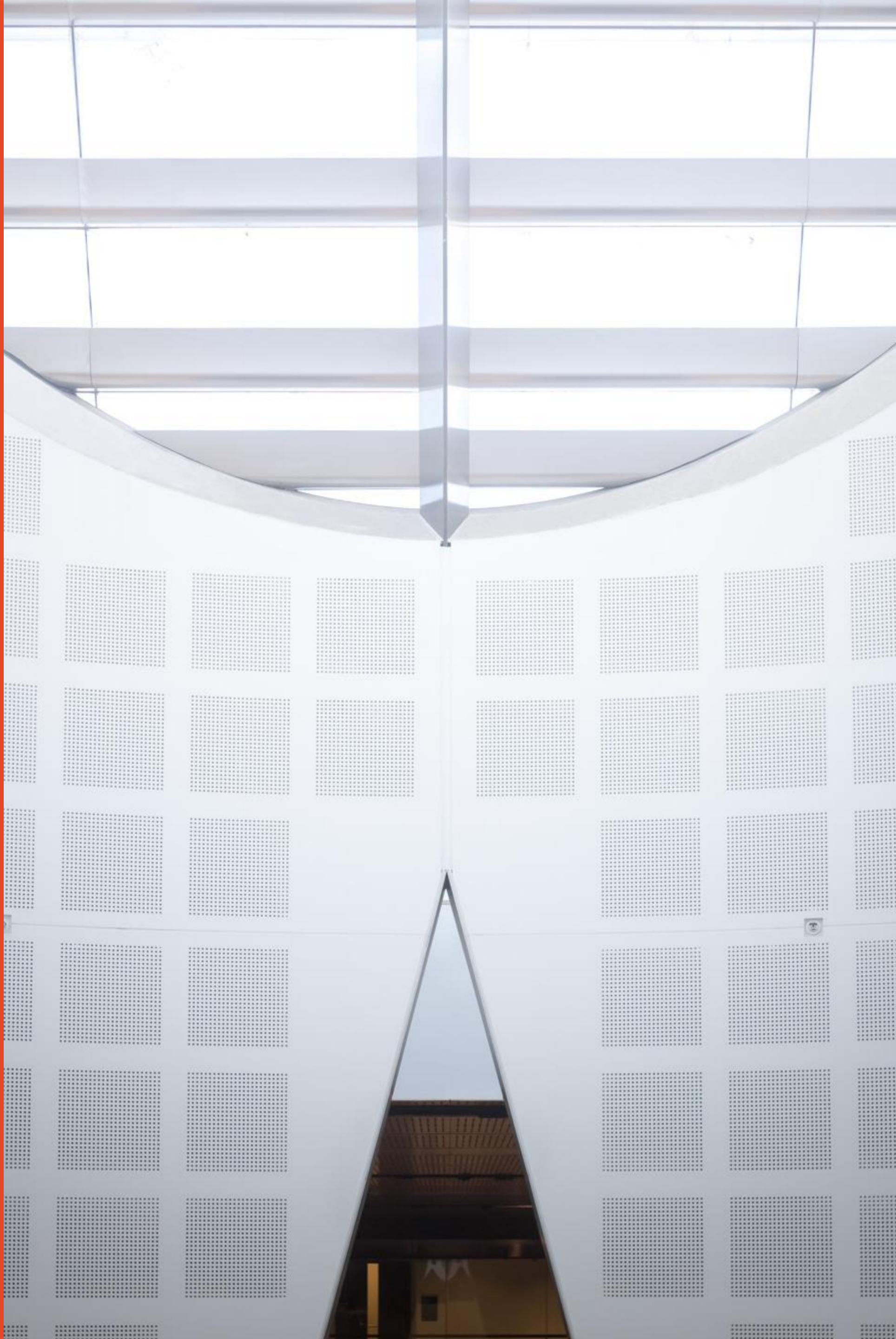
School of Computer Science

THE UNIVERSITY OF SYDNEY



Feedback on Assignment 1

- Did you find Assignment 1 to be challenging?
  - Rate how difficult it was in the scale of 1-5.
  - Do you have prior knowledge in Java programming?
- Was the time enough for Assignment 1?
- Did content covered in tutorials help in doing Assignment 1?
- Do you wish to have extra support for Android programming?
- Would you attend a programming help desk session if organized?

Resources to help you learn

- **Android developer training courses**
  - Codelabs with suggested homework assignments: Codelabs for Android Developer Fundamentals
  - Concept reference chapters: Android Developer Fundamentals — Concepts
  - Source code in GitHub for starter apps and solution code for apps that you create in the codelabs
- The Android Developer YouTube channel is a great source of tutorials and tips.
- Android vocabulary
- Inspire looking at Android Developer Stories
- **Community Support:**
- The Android team posts news and tips in the official Android blog.
- Android developers blog.
- Stack Overflow.
  - If you run into a problem, chances are high that someone has already posted an answer.
  - Type [android] in the search box. The [] brackets indicate that you want to search for posts that have been tagged as being about Android.

Resources to help you learn

- Android developer fundamentals course
  - Unit 1.4: Resources to help you learn

- This page contains a great collection of links to many resources organized into categories;
  - Android Developer documentation
  - Android studio documentation
  - Design
  - Develop
  - Distribute
  - Blogs
  - Other resources

Muddy Cards- Week 4

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Smartphone capabilities

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Smartphone capabilities

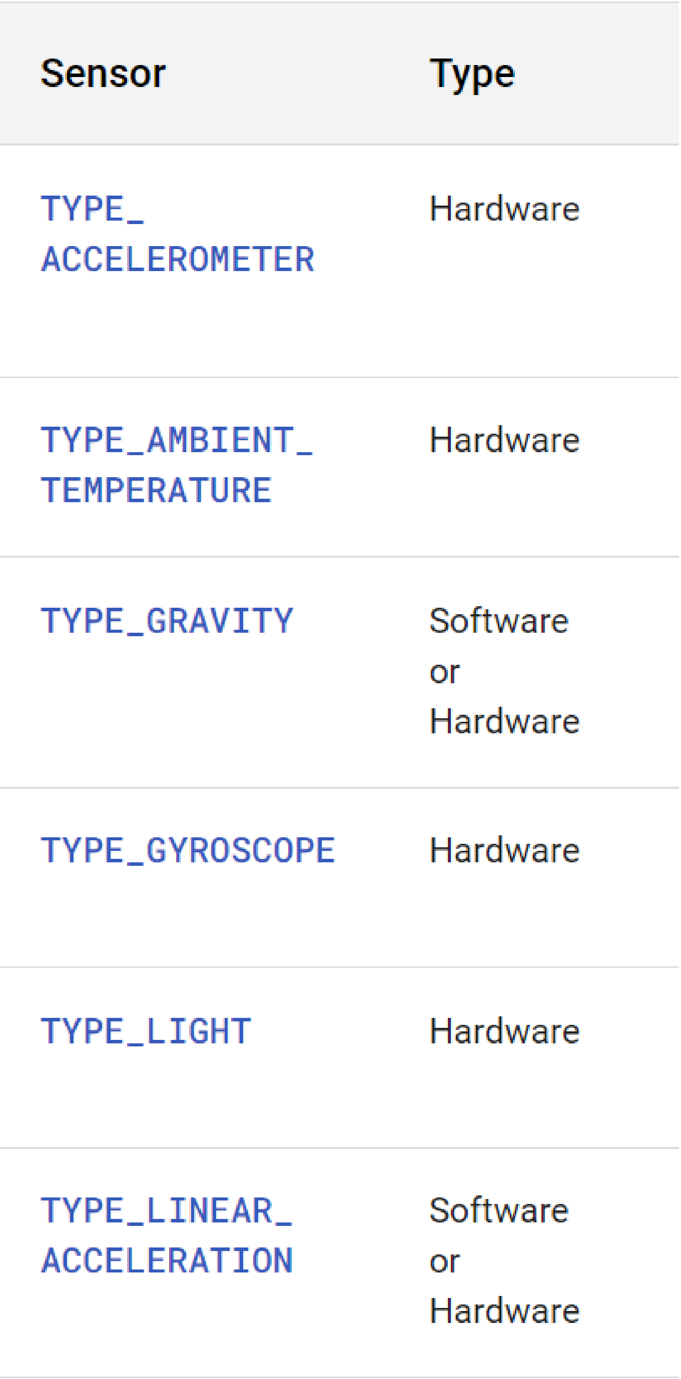
- **Motion –** Accelerometer, Gyroscope
- **Vision –** Multiple Cameras
- **Connectivity –** LTE, WiFi, Bluetooth, NFC
- **Location –** GPS, Assisted GPS
- **Audio –** Speaker, Microphone
- **Haptic –** Touch-screen, buttons
- **Biometric –** HR monitor, Iris scan, Fingerprint scan
- **Environment –** Magnetometer, Barometer, Proximity, Ambient Temperature, Ambient Light, Humidity, Ultraviolet (UV), Moisture, Pressure

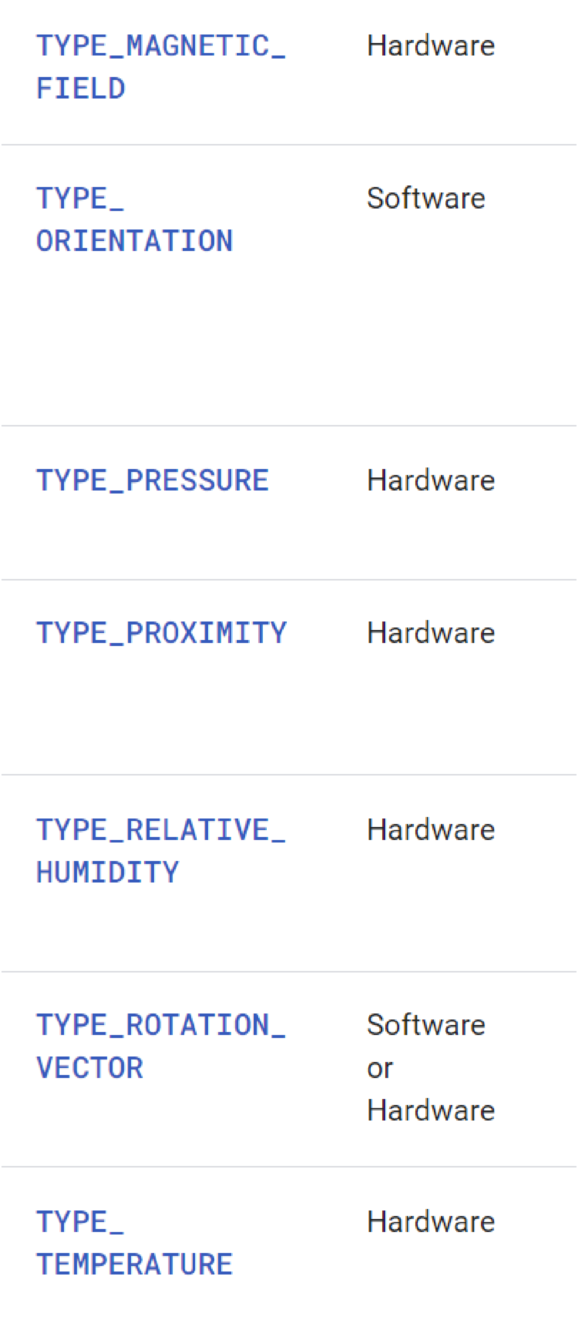
Hardware vs Software

- Hardware capability/sensor
  - Physical components built into a handset
  - E.g. Accelerometer, Gyroscope, Ambient light, Pressure
- Software capability/sensor
  - Derive their data from one or more of the hardware-based sensors
  - E.g. Step Counter, Orientation

- For sensors;
  - Each sensor is accessible through the Android Sensor Framework [1]
  - Sensor availability is based on the actual handset and Android version.

[1] https://developer.android.com/guide/topics/sensors

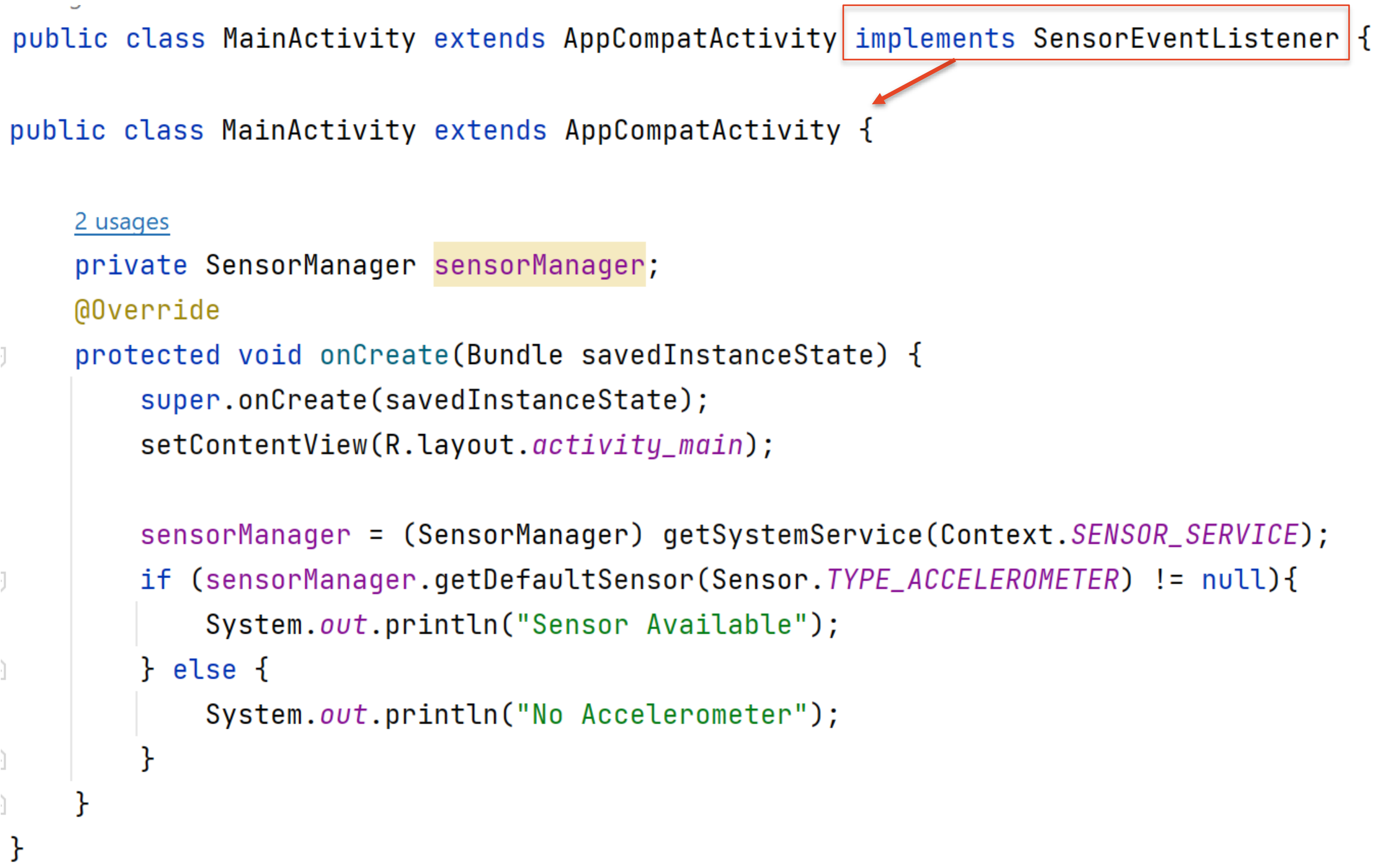




Sensor	Type
TYPE_ACCELEROMETER	Hardware
TYPE_AMBIENT_TEMPERATURE	Hardware
TYPE_GRAVITY	Software or Hardware
TYPE_GYROSCOPE	Hardware
TYPE_LIGHT	Hardware
TYPE_LINEAR_ACCELERATION	Software or Hardware
TYPE_MAGNETIC_FIELD	Hardware
TYPE_ORIENTATION	Software
TYPE_PRESSURE	Hardware
TYPE_PROXIMITY	Hardware
TYPE_RELATIVE_HUMIDITY	Hardware
TYPE_ROTATION_VECTOR	Software or Hardware
TYPE_TEMPERATURE	Hardware

Sensor Framework

- SensorManager : Create an instance of the sensor service. This class provides methods for accessing and listing sensors, registering and unregistering sensor event listeners, and acquiring orientation information.
- Sensor: Create an instance of a specific sensor.
- SensorEvent: Create a sensor event object, which provides information about a sensor event.
  - the raw sensor data
  - the type of sensor that generated the event
  - the accuracy of the data
  - the timestamp for the event.
- SensorEventListener: Create two callback methods that receive notifications (sensor events) when sensor values change or when sensor accuracy changes.

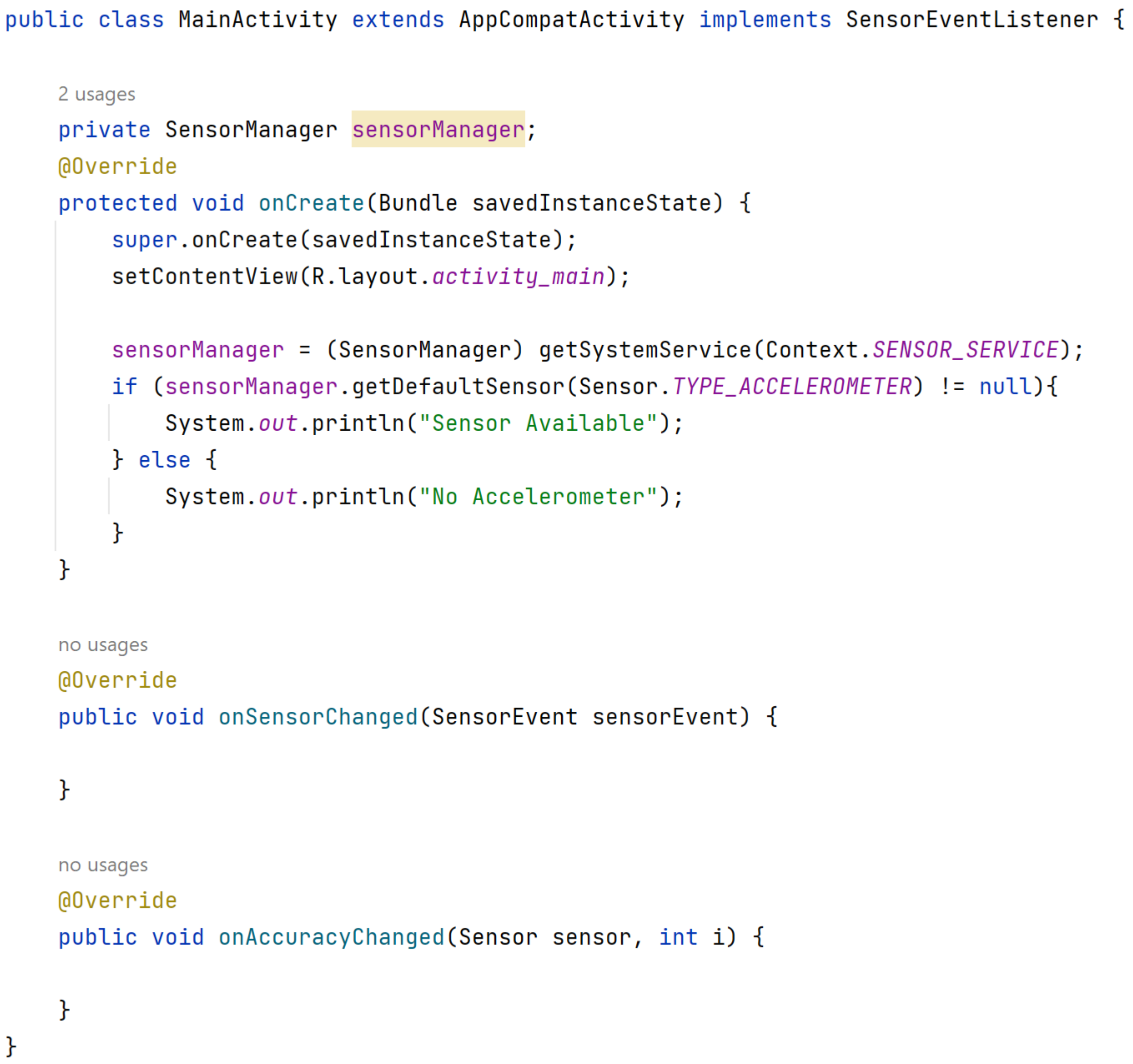


```
public class MainActivity extends AppCompatActivity implements SensorEventListener {

public class MainActivity extends AppCompatActivity {

    2 usages
    private SensorManager sensorManager;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        sensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
        if (sensorManager.getDefaultSensor(Sensor.TYPE_ACCELEROMETER) != null){
            System.out.println("Sensor Available");
        } else {
            System.out.println("No Accelerometer");
        }
    }
}
```



```
public class MainActivity extends AppCompatActivity implements SensorEventListener {

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    private SensorManager sensorManager;
    @Override
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        setContentView(R.layout.activity_main);

        sensorManager = (SensorManager) getSystemService(Context.SENSOR_SERVICE);
        if (sensorManager.getDefaultSensor(Sensor.TYPE_ACCELEROMETER) != null){
            System.out.println("Sensor Available");
        } else {
            System.out.println("No Accelerometer");
        }
    }

    no usages
    @Override
    public void onSensorChanged(SensorEvent sensorEvent) {

    }

    no usages
    @Override
    public void onAccuracyChanged(Sensor sensor, int i) {

    }
}
```
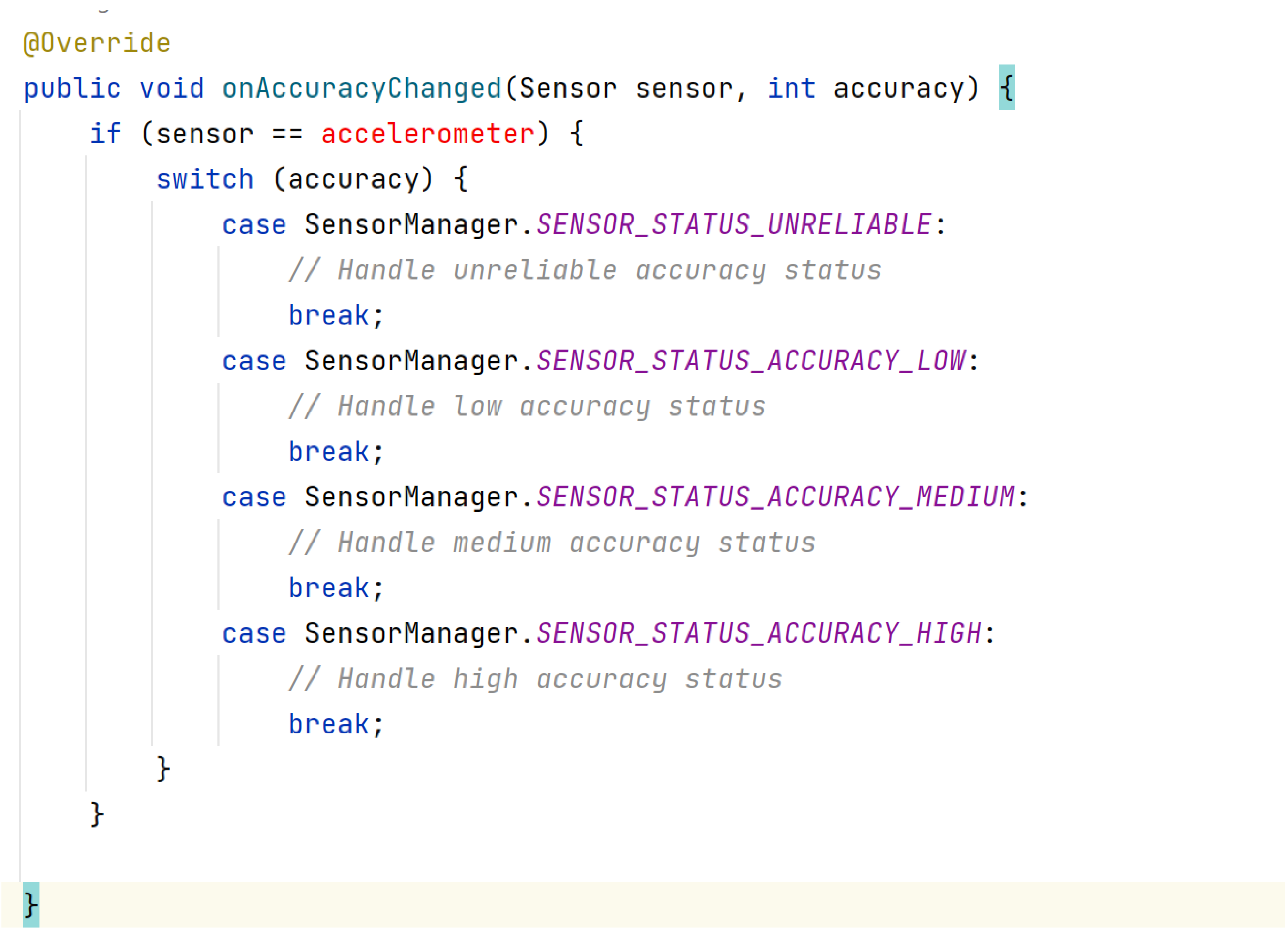
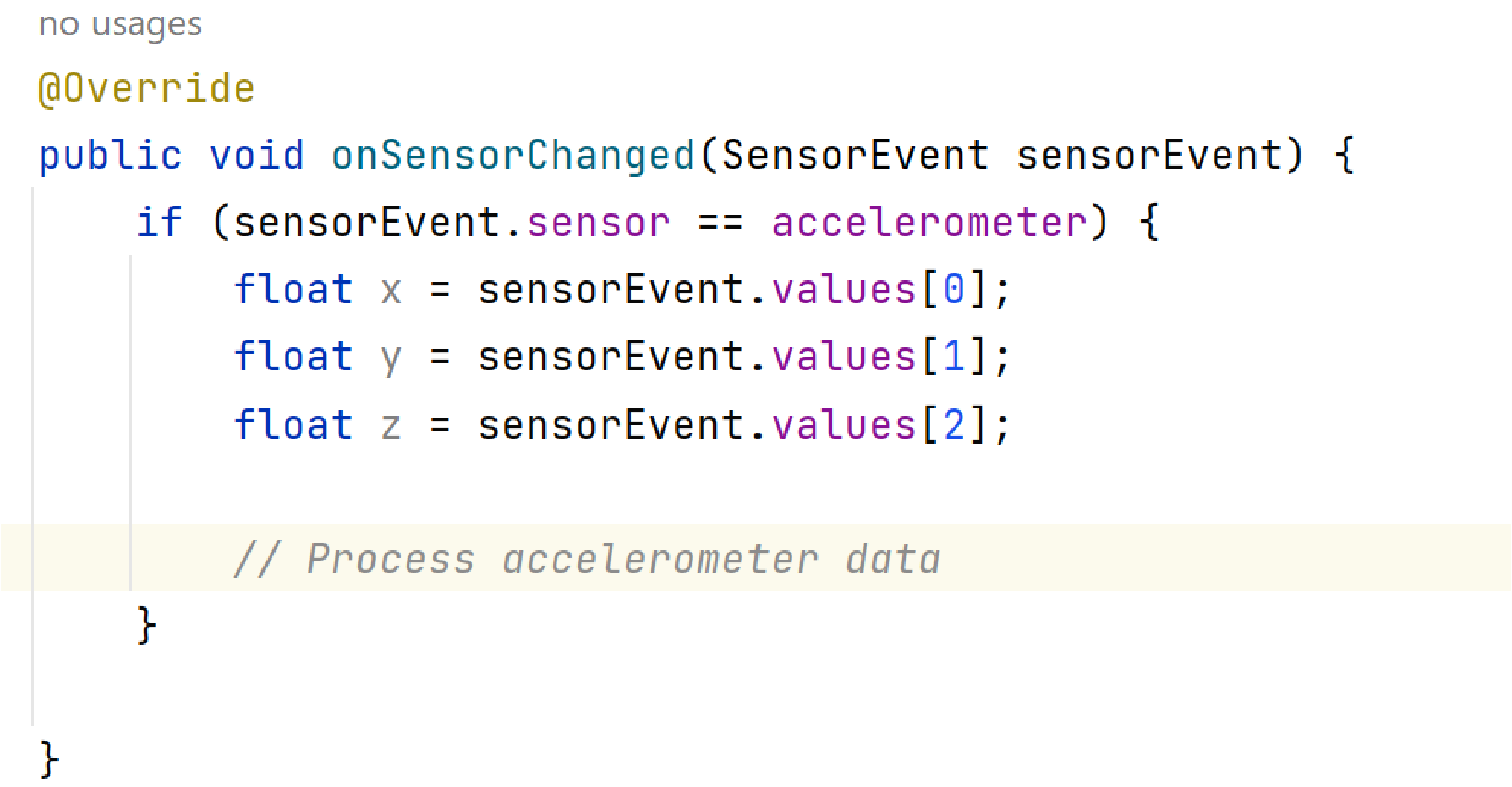
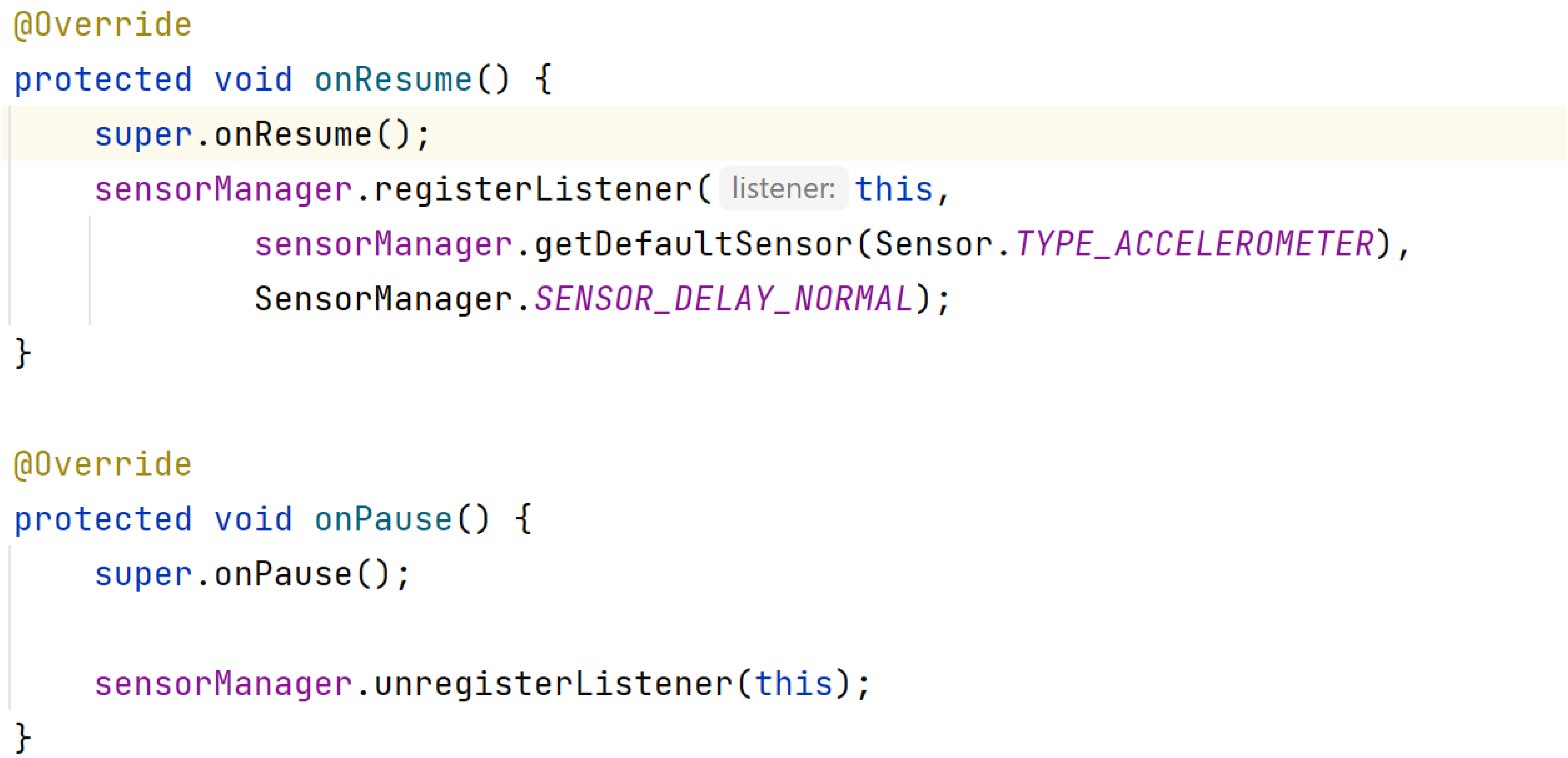



```java
@Override
public void onAccuracyChanged(Sensor sensor, int accuracy) {
    if (sensor == accelerometer) {
        switch (accuracy) {
            case SensorManager.SENSOR_STATUS_UNRELIABLE:
                // Handle unreliable accuracy status
                break;
            case SensorManager.SENSOR_STATUS_ACCURACY_LOW:
                // Handle low accuracy status
                break;
            case SensorManager.SENSOR_STATUS_ACCURACY_MEDIUM:
                // Handle medium accuracy status
                break;
            case SensorManager.SENSOR_STATUS_ACCURACY_HIGH:
                // Handle high accuracy status
                break;
        }
    }

}
```

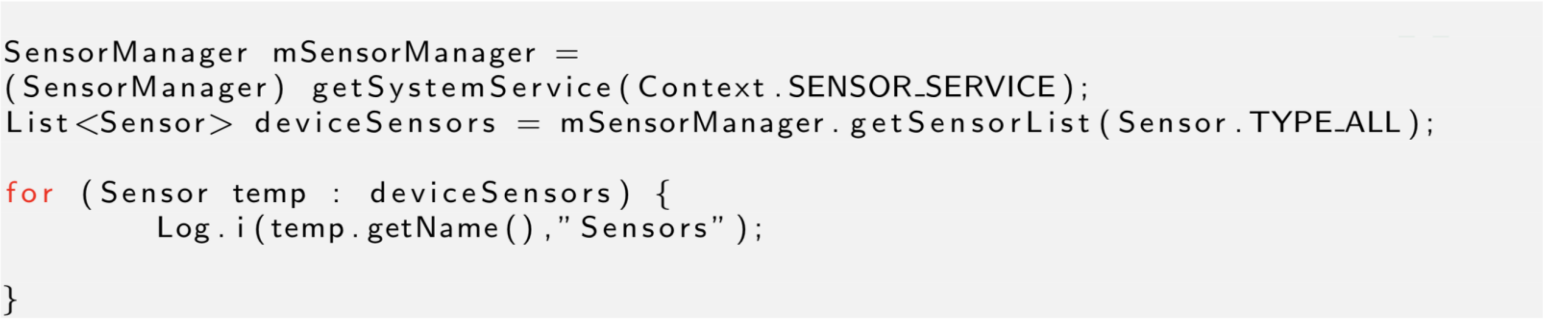


```
no usages
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
    if (sensorEvent.sensor == accelerometer) {
        float x = sensorEvent.values[0];
        float y = sensorEvent.values[1];
        float z = sensorEvent.values[2];

        // Process accelerometer data
    }

}
```



```
@Override
protected void onResume() {
    super.onResume();
    sensorManager.registerListener( listener: this,
            sensorManager.getDefaultSensor(Sensor.TYPE_ACCELEROMETER),
            SensorManager.SENSOR_DELAY_NORMAL);
}

@Override
protected void onPause() {
    super.onPause();

    sensorManager.unregisterListener(this);
}
```

Listing sensors in a device



```
SensorManager mSensorManager =
(SensorManager) getSystemService(Context.SENSOR_SERVICE);
List<Sensor> deviceSensors = mSensorManager.getSensorList(Sensor.TYPE_ALL);

for (Sensor temp : deviceSensors) {
        Log.i(temp.getName(),"Sensors");

}
```

E.g. List of sensors in Android

- Proximity
- Light
- Accelerometer
- Gyroscope
- Gyroscope (uncalibrated)
- Magnetometer
- Magnetometer (uncalibrated)
- Pressure
- Orientation
- Step detector
- Step counter
- Significant motion
- Gravity
- Linear Acceleration
- Rotation Vector
- Geomagnetic Rotation Vector
- Temperature
- Game Rotation Vector
- Tilt Detector
- Pickup Gesture
- Sensors Sync
- Double Twist
- Double Tap
- Window Orientation

Types of Sensors

The Android platform supports three broad categories of sensors:

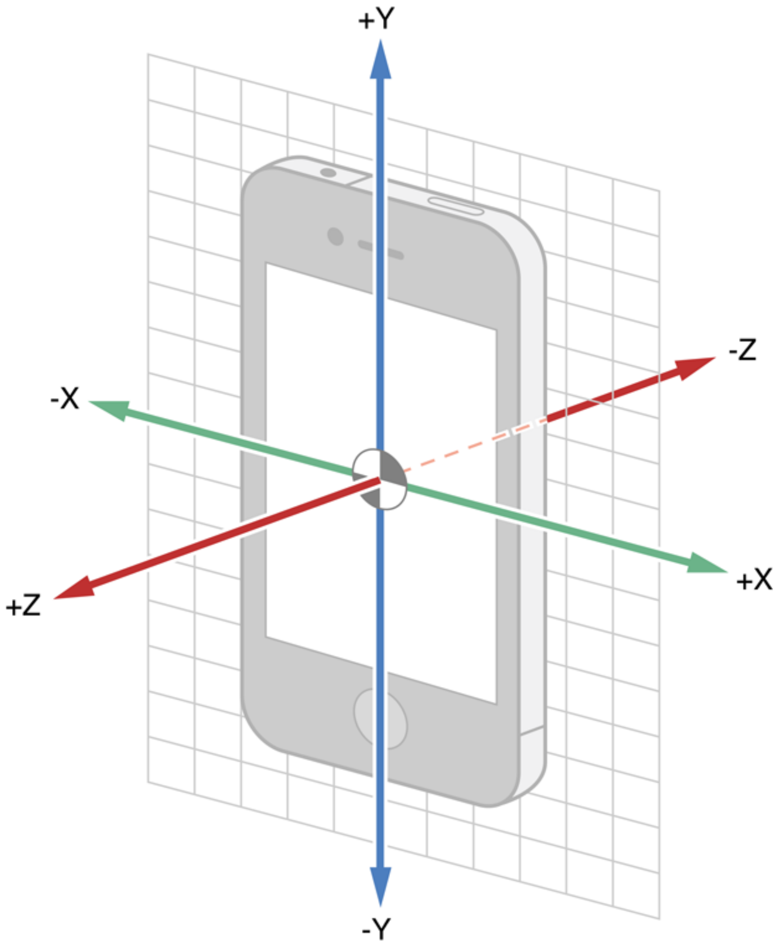
- Motion sensors: These sensors measure acceleration forces and rotational forces along three axes.
- Environmental sensors: These sensors measure various environmental parameters
- Position sensors: These sensors measure the physical position of a device.

Motion Sensors

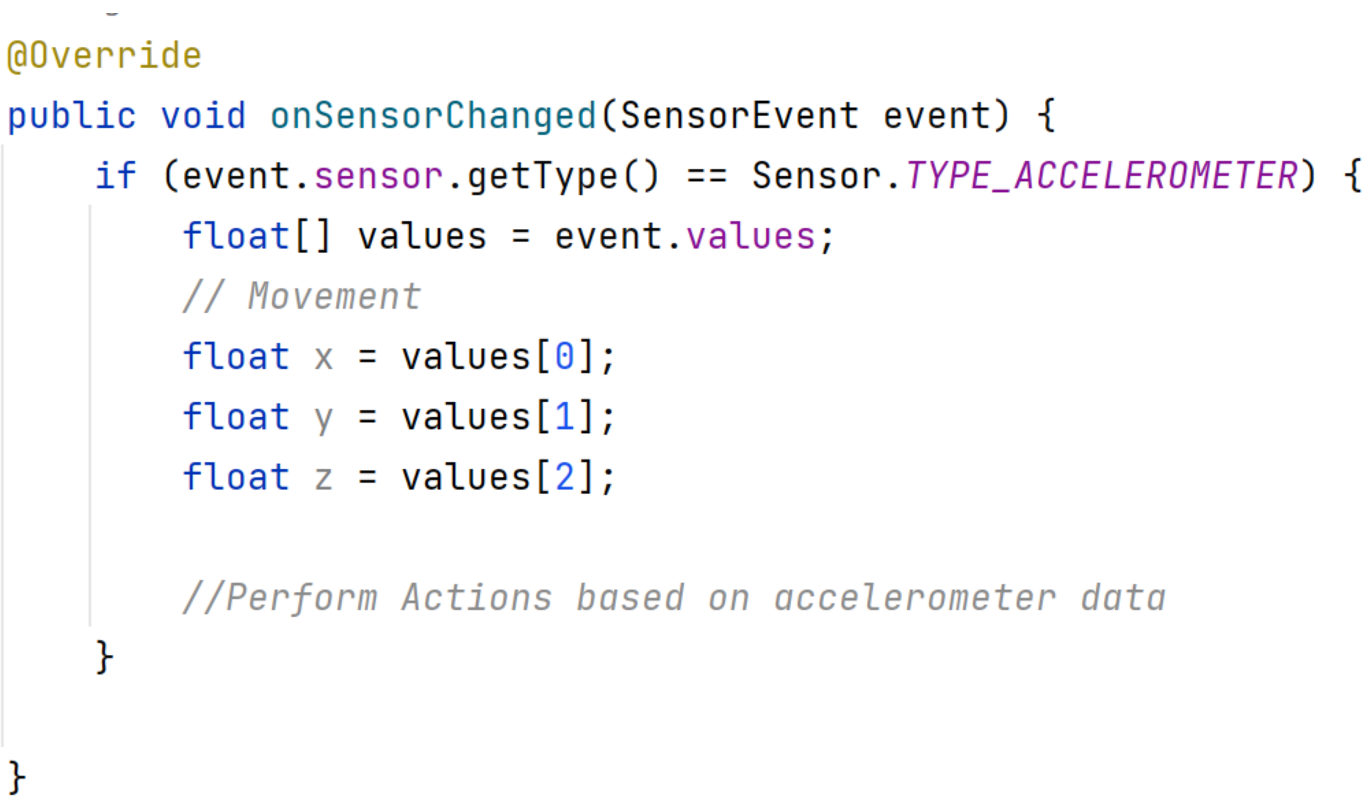
- Motion sensors are useful for monitoring device movement, such as tilt, shake, rotation, or swing.
- The Android platform provides several sensors that let you monitor the motion of a device. Two of these sensors are always hardware-based (the accelerometer and gyroscope), and three of these sensors can be either hardware-based or software-based (the gravity, linear acceleration, and rotation vector sensors)

Motion Sensor- Accelerometer

- Measures acceleration forces along three different axes: X, Y, and Z.
- These axes are aligned with the device's orientation, with the X-axis usually pointing from left to right, the Y-axis pointing from top to bottom, and the Z-axis perpendicular to the device's screen.



Motion Sensor- Accelerometer

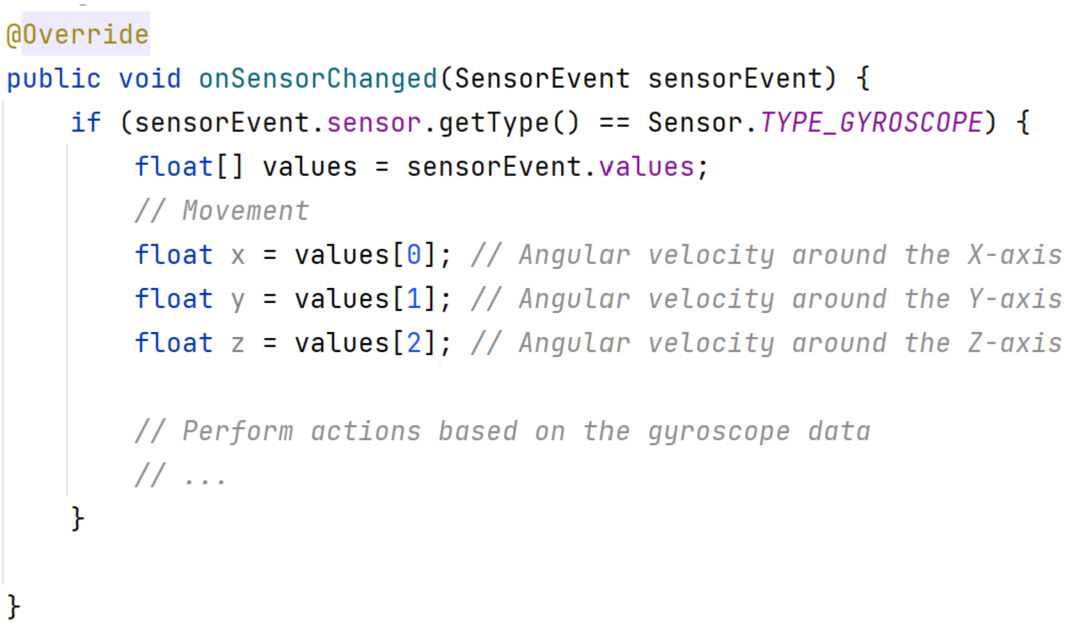


```
@Override
public void onSensorChanged(SensorEvent event) {
    if (event.sensor.getType() == Sensor.TYPE_ACCELEROMETER) {
        float[] values = event.values;
        // Movement
        float x = values[0];
        float y = values[1];
        float z = values[2];

        //Perform Actions based on accelerometer data
    }

}
```

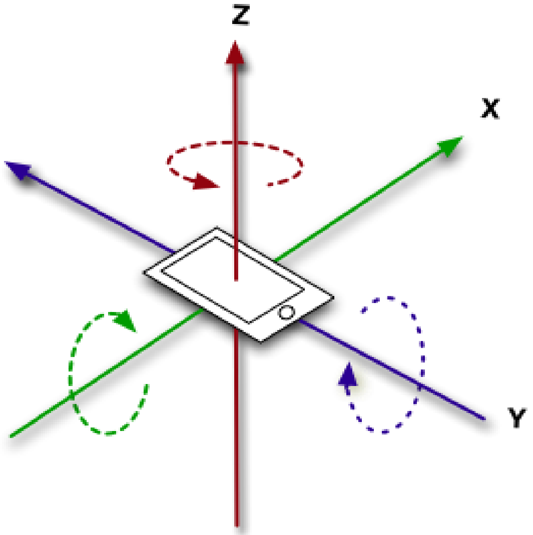
Motion Sensor- Gyroscope

- Gyroscope measures the rate of rotation in rad/s around a device’s x, y, and z axis

- Provides precise device orientation than accelerometer
- Often used in combination with accelerometer



```
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
    if (sensorEvent.sensor.getType() == Sensor.TYPE_GYROSCOPE) {
        float[] values = sensorEvent.values;
        // Movement
        float x = values[0]; // Angular velocity around the X-axis
        float y = values[1]; // Angular velocity around the Y-axis
        float z = values[2]; // Angular velocity around the Z-axis

        // Perform actions based on the gyroscope data
        // ...
    }

}
```



Motion Sensor- Gyroscope

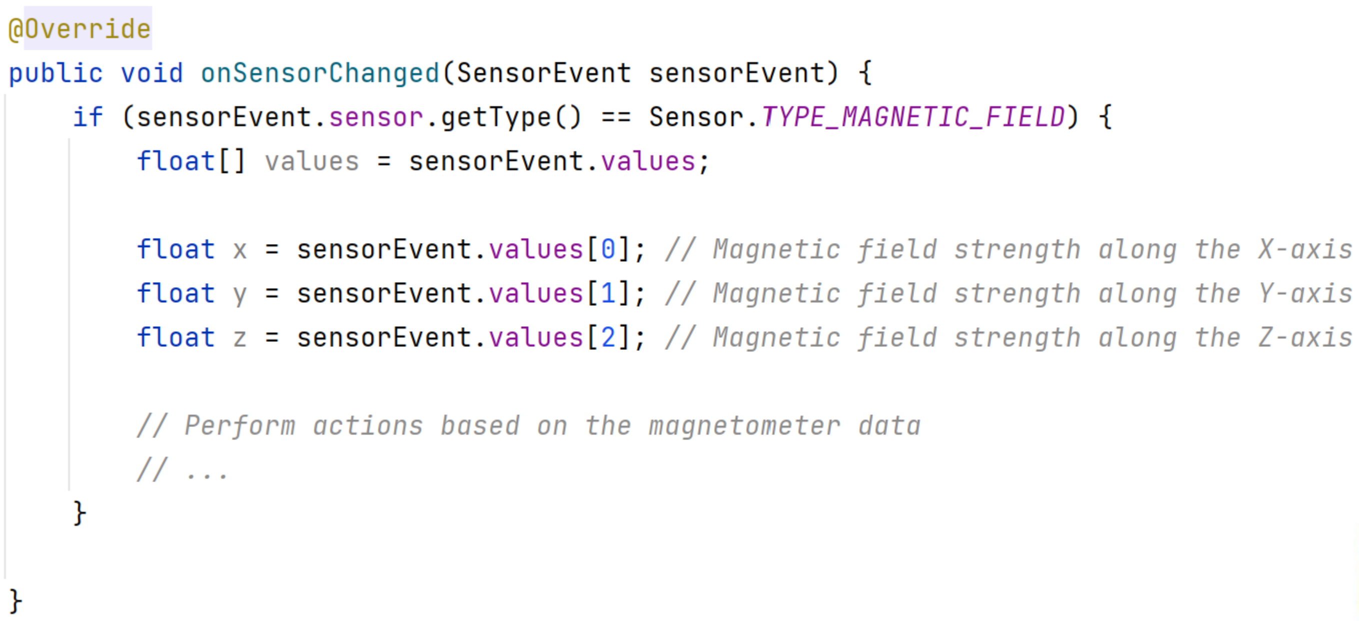
- Gyroscopes are sensitive to drift over time
- Can suffer from cumulative errors when integrating angular velocity to obtain orientation
  - gyroscopic drift
- Sensor fusion
  - Combining data from multiple sensors, such as gyroscopes and accelerometers, can help compensate for each sensor's weaknesses.
  - Algorithms like complementary filters and Kalman filters are used to merge data and provide more accurate orientation estimates.

Motion Sensor- What can we do

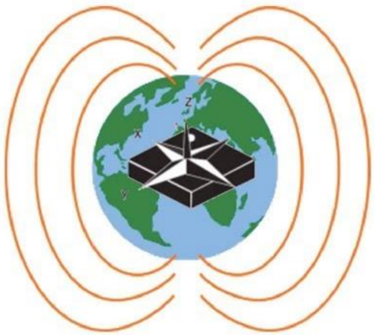
1. Screen Orientation: Motion sensors are used to detect the device's orientation and adjust the screen accordingly.
2. Gaming: Motion sensors enable motion-based gaming, allowing users to control games by tilting or moving the device.
3. Gestures and Gestural Navigation: Motion sensors can recognize gestures like shaking, flipping, tapping, and more.
4. Step Counting and Fitness Tracking: Accelerometers can be used to estimate the number of steps a user takes, allowing for basic fitness tracking and activity monitoring.
5. Augmented Reality (AR) and Virtual Reality (VR): Accurate motion tracking is crucial in AR and VR applications to align virtual objects with the real world and provide an immersive experience.
6. Camera Stabilization: Gyroscopes and accelerometers help stabilize the camera during video recording or photography
7. Panorama Photography: Motion sensors assist in capturing panoramic photos by guiding users in capturing a series of images that can be stitched together to create a wide-angle image.
8. Fall Detection: Motion sensors can be used to detect sudden movements indicative of a fall.
9. Context Awareness: By analyzing motion sensor data along with other sensor inputs, apps can provide context-aware features

Position sensors: Magnetometer

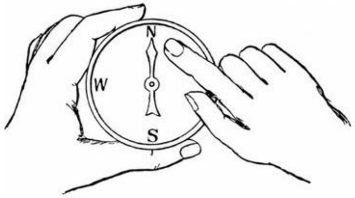
– Detect magnetic fields (e.g. earth magnetic field)



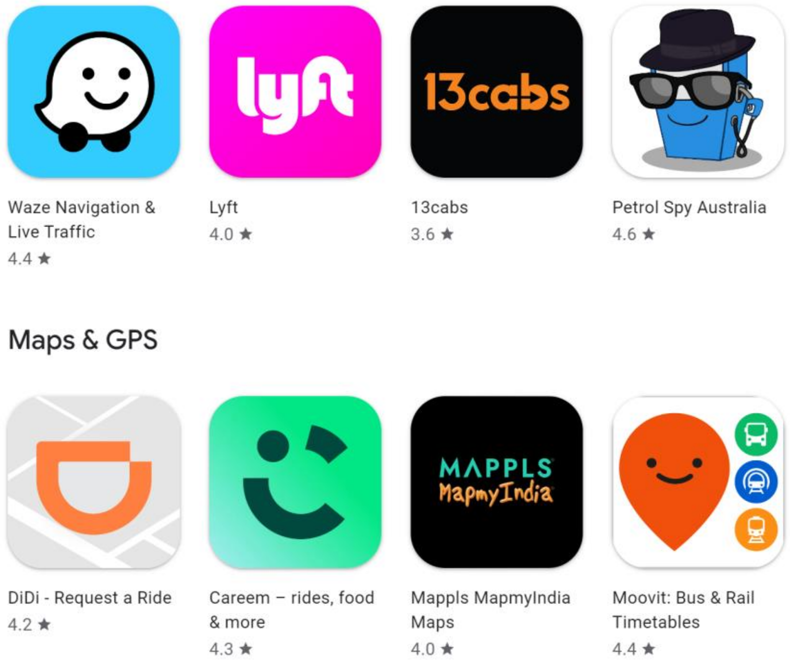
```
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
    if (sensorEvent.sensor.getType() == Sensor.TYPE_MAGNETIC_FIELD) {
        float[] values = sensorEvent.values;

        float x = sensorEvent.values[0]; // Magnetic field strength along the X-axis
        float y = sensorEvent.values[1]; // Magnetic field strength along the Y-axis
        float z = sensorEvent.values[2]; // Magnetic field strength along the Z-axis

        // Perform actions based on the magnetometer data
        // ...
    }

}
```



What else can we do ?



Magnetometer



Waze Navigation & Live Traffic
4.4 ★

Lyft
4.0 ★

13cabs
3.6 ★

Petrol Spy Australia
4.6 ★

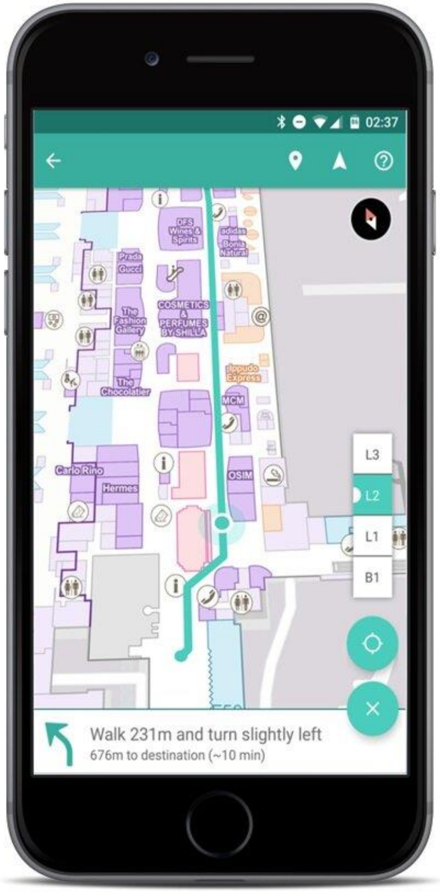
Maps & GPS

DiDi - Request a Ride
4.2 ★

Careem – rides, food & more
4.3 ★

Mappls MapmyIndia Maps
4.0 ★

Moovit: Bus & Rail Timetables
4.4 ★



Walk 231m and turn slightly left
676m to destination (~10 min)

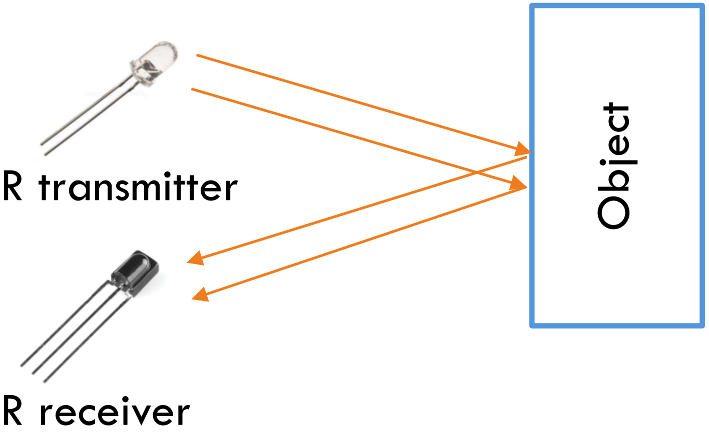
Magnetometer EMF
ExaMobile S.A.
4.2 ★

Metal Detector
Smart Tools co.
4.0 ★

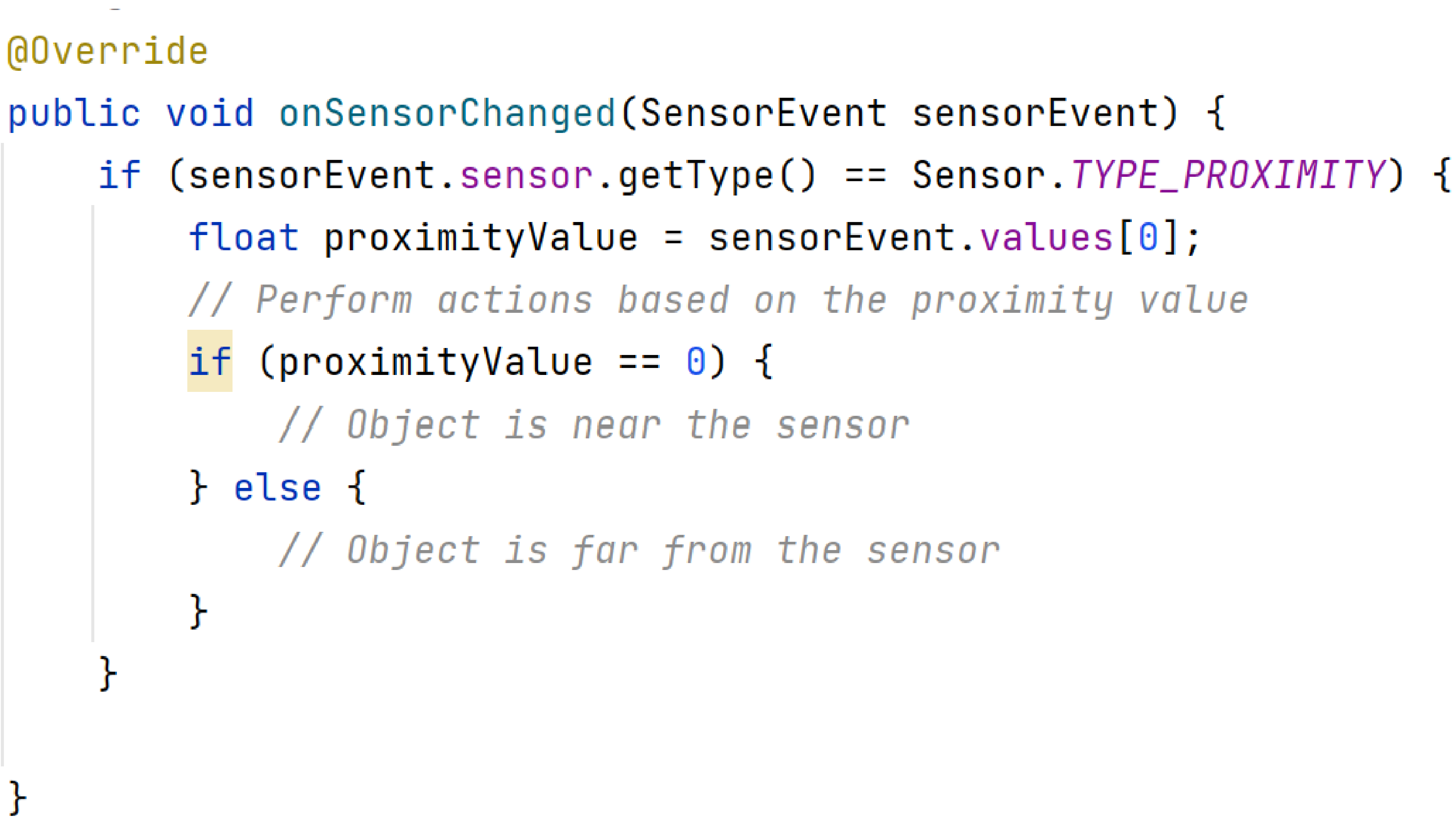
Metal Detector - Metal Finder
SpyWire Tech
4.7 ★

Position sensors: Proximity sensor

- Detects the presence of an object, usually a person's hand or face, near the device's screen.
- Infrared (IR) LED (Transmitter) and IR Receiver
- Not visible to human eye



- What is the most common use case of proximity sensor ?

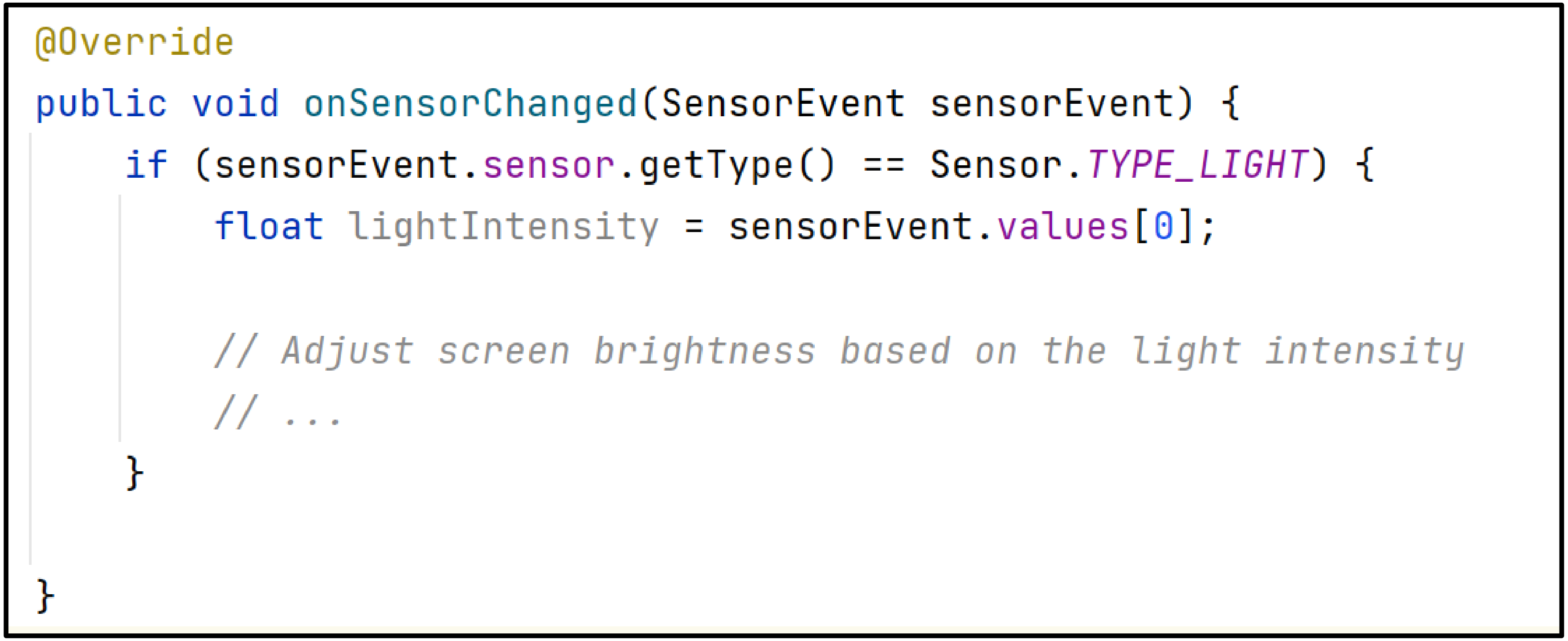


```java
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
    if (sensorEvent.sensor.getType() == Sensor.TYPE_PROXIMITY) {
        float proximityValue = sensorEvent.values[0];
        // Perform actions based on the proximity value
        if (proximityValue == 0) {
            // Object is near the sensor
        } else {
            // Object is far from the sensor
        }
    }

}
```

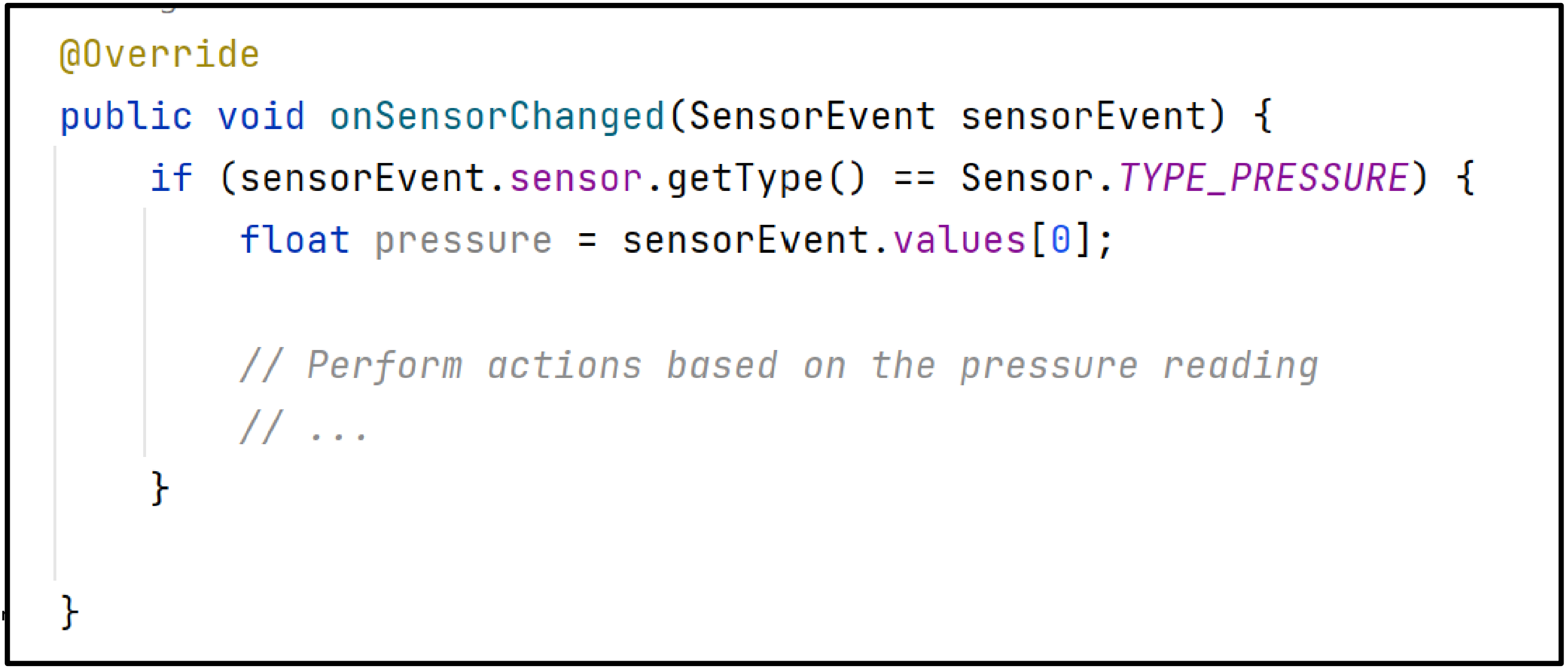
https://www.geeksforgeeks.org/how-to-use-proximity-sensor-in-android/

Environment sensors

- Ambient Light
  - Adjust screen brightness – Why ?
- Atmospheric pressure sensor – Barometer
  - Improve GPS accuracy – How (HW) ?
- Temperature sensor
  - Shuts device down if overheated
- Humidity sensor
  - Contributes to air quality measurements



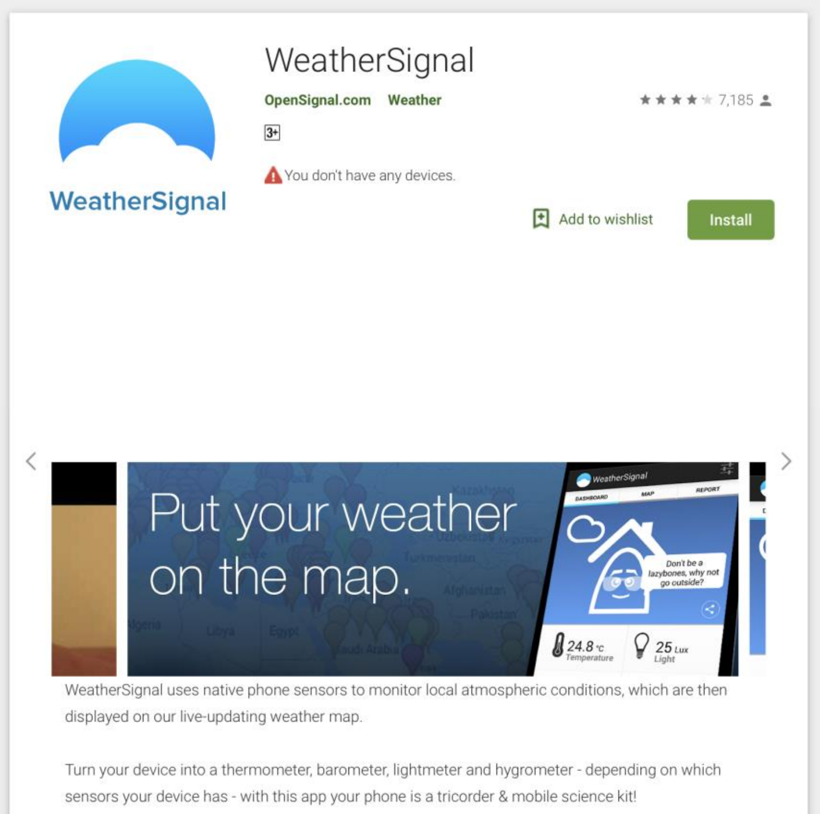
```
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
    if (sensorEvent.sensor.getType() == Sensor.TYPE_LIGHT) {
        float lightIntensity = sensorEvent.values[0];

        // Adjust screen brightness based on the light intensity
        // ...
    }

}
```



```
@Override
public void onSensorChanged(SensorEvent sensorEvent) {
    if (sensorEvent.sensor.getType() == Sensor.TYPE_PRESSURE) {
        float pressure = sensorEvent.values[0];

        // Perform actions based on the pressure reading
        // ...
    }

}
```

Environment sensors

- Ambient Temperature, Ambient Light, Humidity, Ultraviolet (UV), Moisture, Pressure
- Crowdsourced weather apps



WeatherSignal

OpenSignal.com Weather

★★★★☆ 7,185

3+

You don't have any devices.

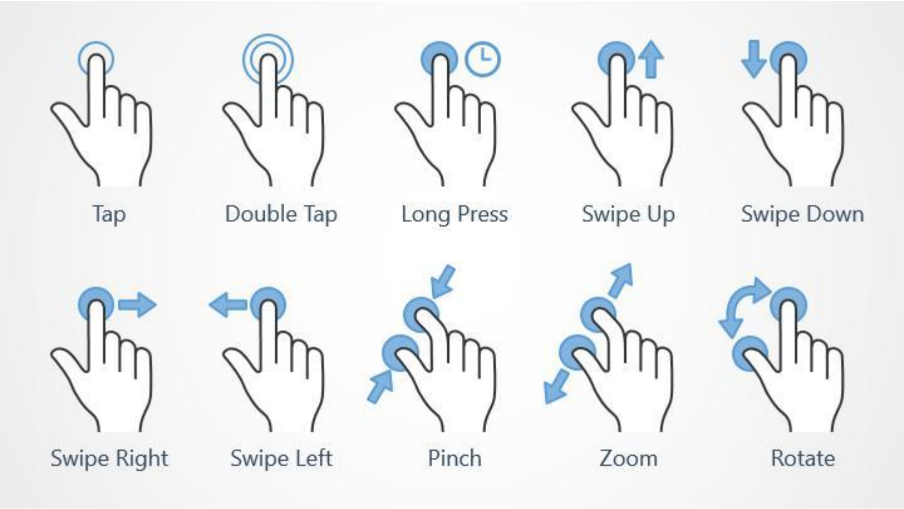
WeatherSignal uses native phone sensors to monitor local atmospheric conditions, which are then displayed on our live-updating weather map.

Turn your device into a thermometer, barometer, lightmeter and hygrometer - depending on which sensors your device has - with this app your phone is a tricorder & mobile science kit!

Other Capabilities

Haptic

- **Touchscreen** - Advanced user interaction methods
  - Multiple modes of touch
  - Multiple modes of swipe



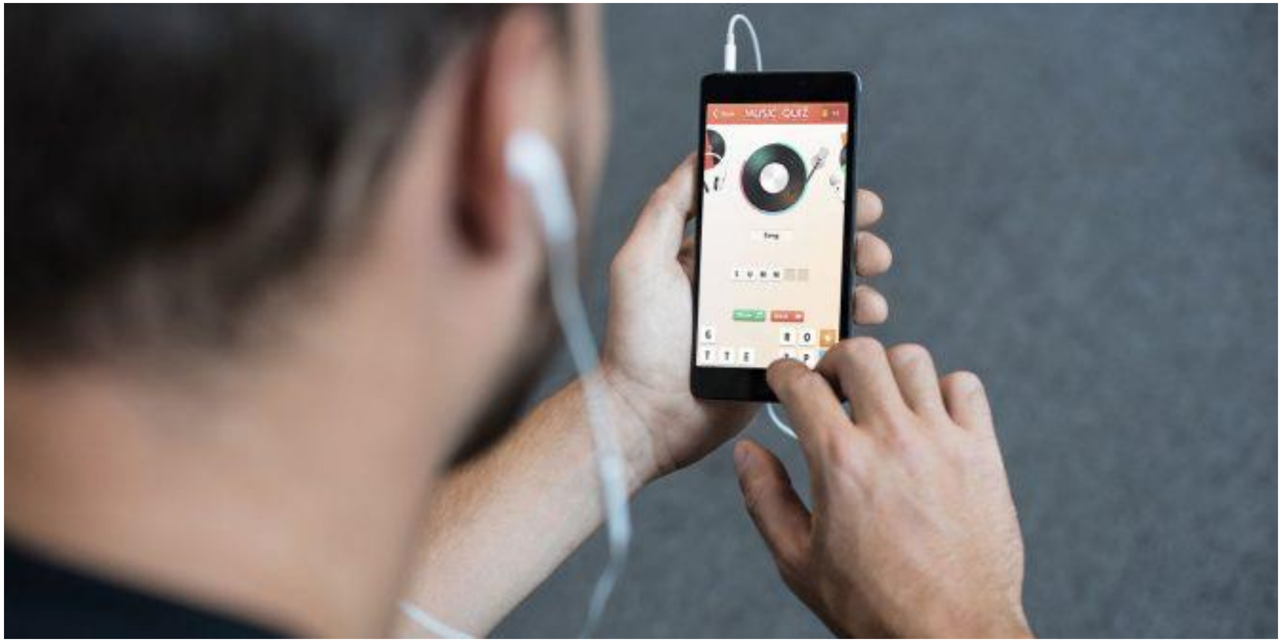
What else can we do ?

Research on haptics

- Touch patterns for user authentication
  - Alexander De Luca, Alina Hang, Frederik Brudy, Christian Lindner, and Heinrich Hussmann. 2012. Touch me once and i know it's you! implicit authentication based on touch screen patterns. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12). Association for Computing Machinery, New York, NY, USA, 987–996.
- Touch for cross-device tracking of usage
  - Masood, R., Zhao, B. Z. H., Asghar, H. J.,&Kaafar, M. A. (2018). Touch and You're Trapp (ck) ed: Quantifying the Uniqueness of Touch Gestures for Tracking. *Proceedings on Privacy Enhancing Technologies*, *2018*(2), 122-142.
- Soft biometric prediction using touch characteristics
  - Gender, age
  - Emotion
  - Miguel-Hurtado, O., Stevenage, S. V., Bevan, C.,&Guest, R. (2016). Predicting sex as a soft-biometrics from device interaction swipe gestures. *Pattern Recognition Letters*, *79*, 44-51.
- Touch to enable parental controlling on the phone
  - X. Li, S. Malebary, X. Qu, X. Ji, Y. Cheng, and W. Xu, “icare: Automatic and user-friendly child identification on smartphones,” in Proceedings of the 19th International Workshop on Mobile Computing Systems; Applications, ser. HotMobile ’18. New York, NY, USA: ACM, 2018, pp. 43–48.

Audio

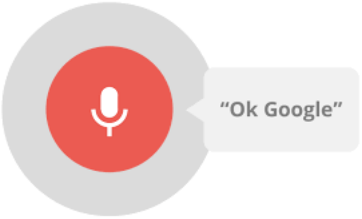
- Speakers
- Microphones



What else can we do ?

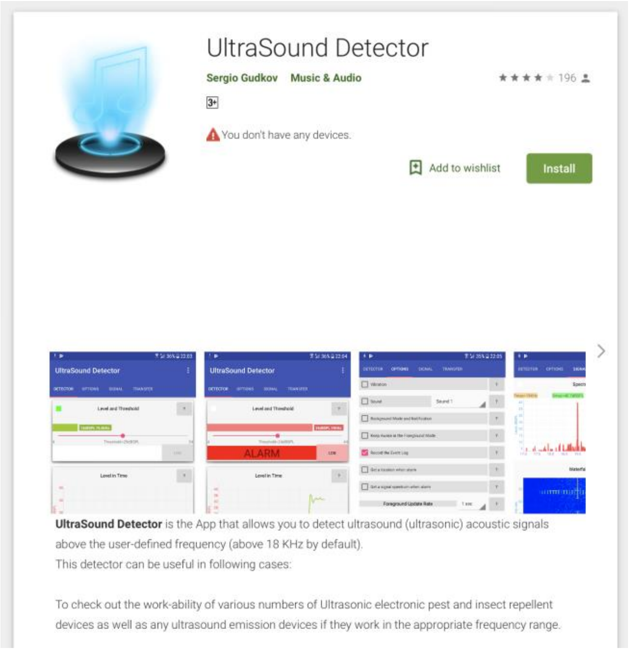
Audio

- **Voice Recognition**
  - Personal assistants – "Hey Siri" and "OK Google"
  - Driven by the recent advances of deep machine learning



- **Ultra-sound** (beyond 18kHz) based solutions

- How can we use Audio as a sensor for Advertising ?
  - Bill-boards, web-pages, TV ads, retail-stores emit "**ultrasonic beacons**" with unique audio sequences



UltraSound Detector

Sergio Gudkov Music & Audio ★★★★☆ 196

3+

You don't have any devices.

UltraSound Detector is the App that allows you to detect ultrasound (ultrasonic) acoustic signals above the user-defined frequency (above 18 KHz by default).
This detector can be useful in following cases:

To check out the work-ability of various numbers of Ultrasonic electronic pest and insect repellent devices as well as any ultrasound emission devices if they work in the appropriate frequency range.

Audio

- Encounter profiling
  - Huanle Zhang, Wan Du, Pengfei Zhou, Mo Li, and Prasant Mohapatra. 2016. DopEnc: acoustic-based encounter profiling using smartphones. In Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking (MobiCom '16). ACM, New York, NY, USA, 294-307.

- BreathPrint: breathing acoustic for user authentication
  - Chauhan, J., Hu, Y., Seneviratne, S., Misra, A., Seneviratne, A.,&Lee, Y. (2017, June). BreathPrint: Breathing acoustics-based user authentication. In *Proceedings of the 15th Annual International Conference on Mobile Systems, Applications, and Services* (pp. 278-291). ACM.

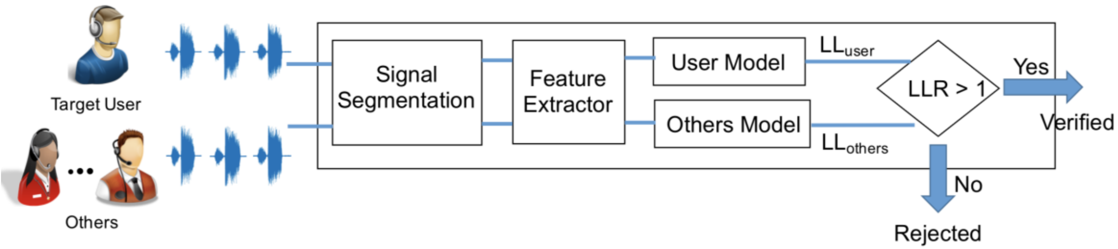
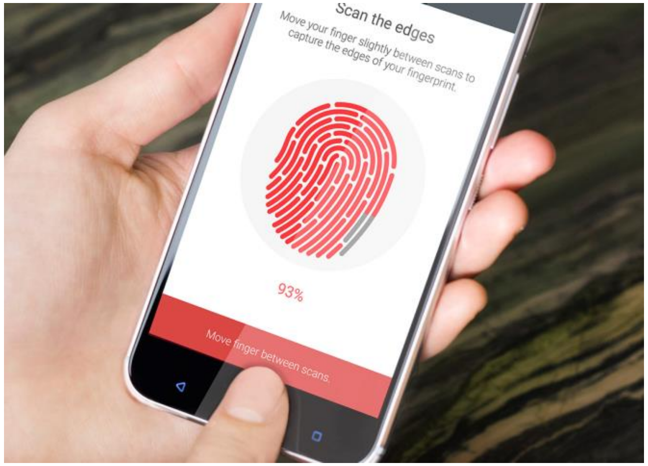
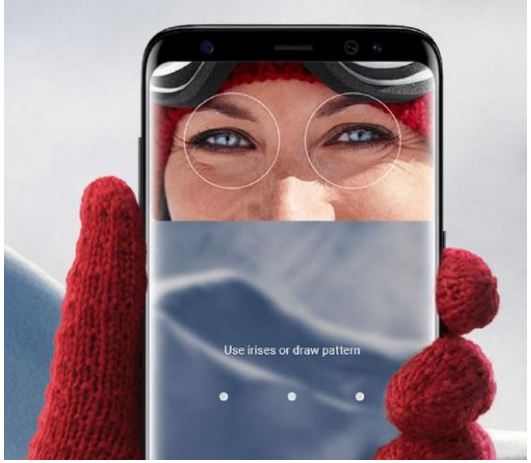


Figure 5: *BreathPrint*: System Architecture

Biometric sensors

- **Fingerprint** and **Iris** scanning for authentication


Scan the edges
Move your finger slightly between scans to capture the edges of your fingerprint.
93%
Move finger between scans.



- Samsung Galaxy S9 comes with a heart rate, blood oxygen level sensor
  - Another IR base sensor
  - Measure the characteristics of the received signal

Camera

- 4K videos with 30fps
- Multiple cameras on one device

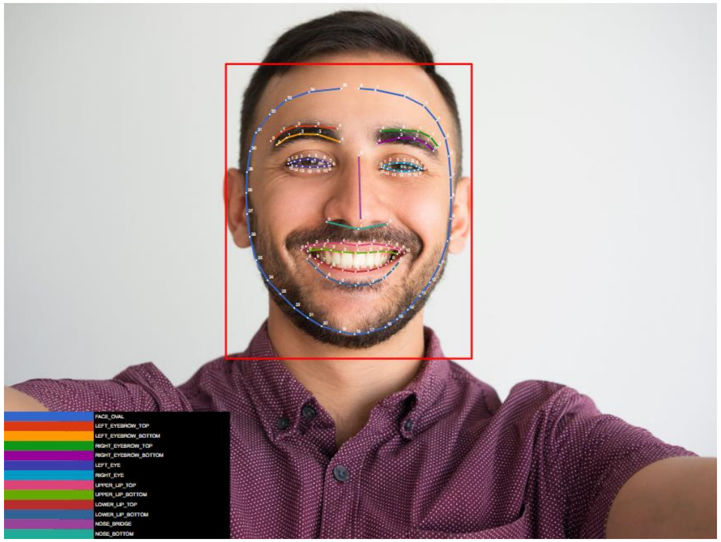
What else can we do ?

Beyond photos and videos – ML KIT

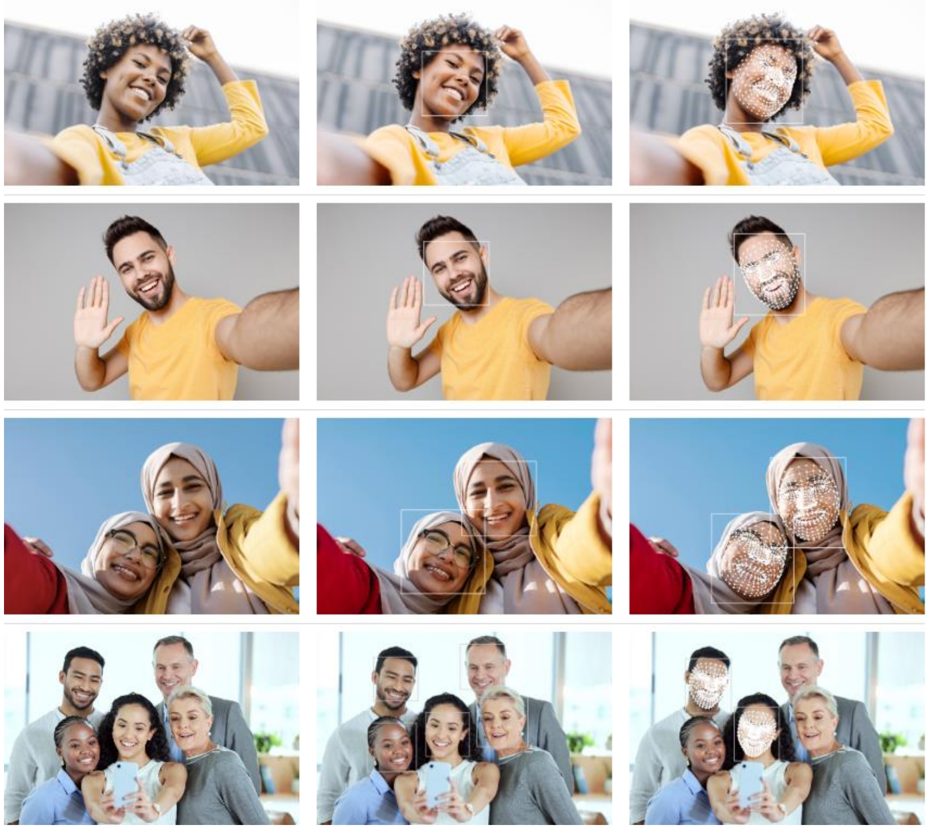
- **Vision APIs**
  - Video and image analysis APIs to label images and detect barcodes, text, faces, and objects.
- **Natural language APIs**
  - Natural language processing APIs to identify and translate between 58 languages and provide reply suggestions.

Beyond photos and videos – ML KIT

- Face and Face mesh detection



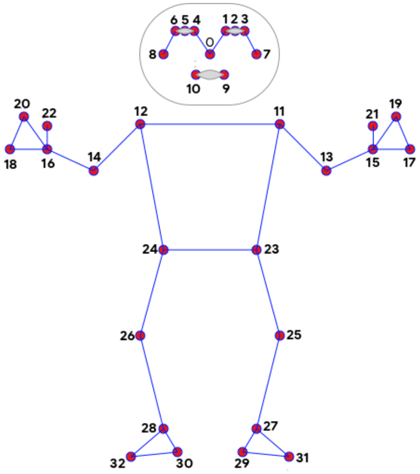
https://developers.google.com/ml-kit/vision/face-detection



https://developers.google.com/ml-kit/vision/face-mesh-detection

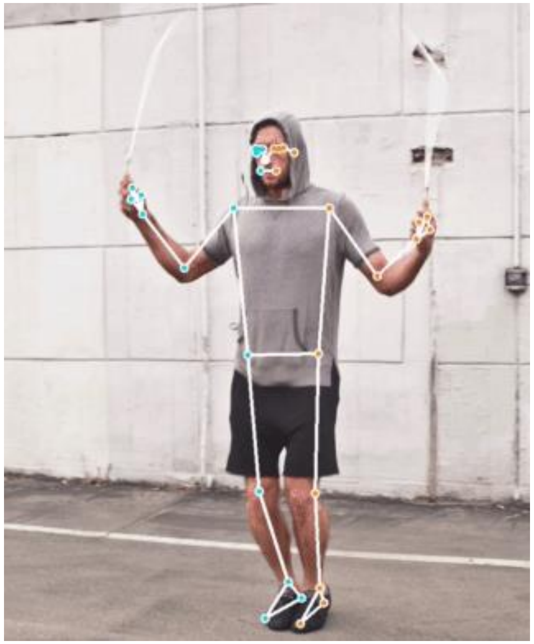
Beyond photos and videos – ML KIT

- Pose detection - a computer vision task that includes detecting, associating, and tracking semantic key points (i.e “right shoulders,” “left knees”) .
- to detect the pose of a subject's body in real time from a continuous video or static image.

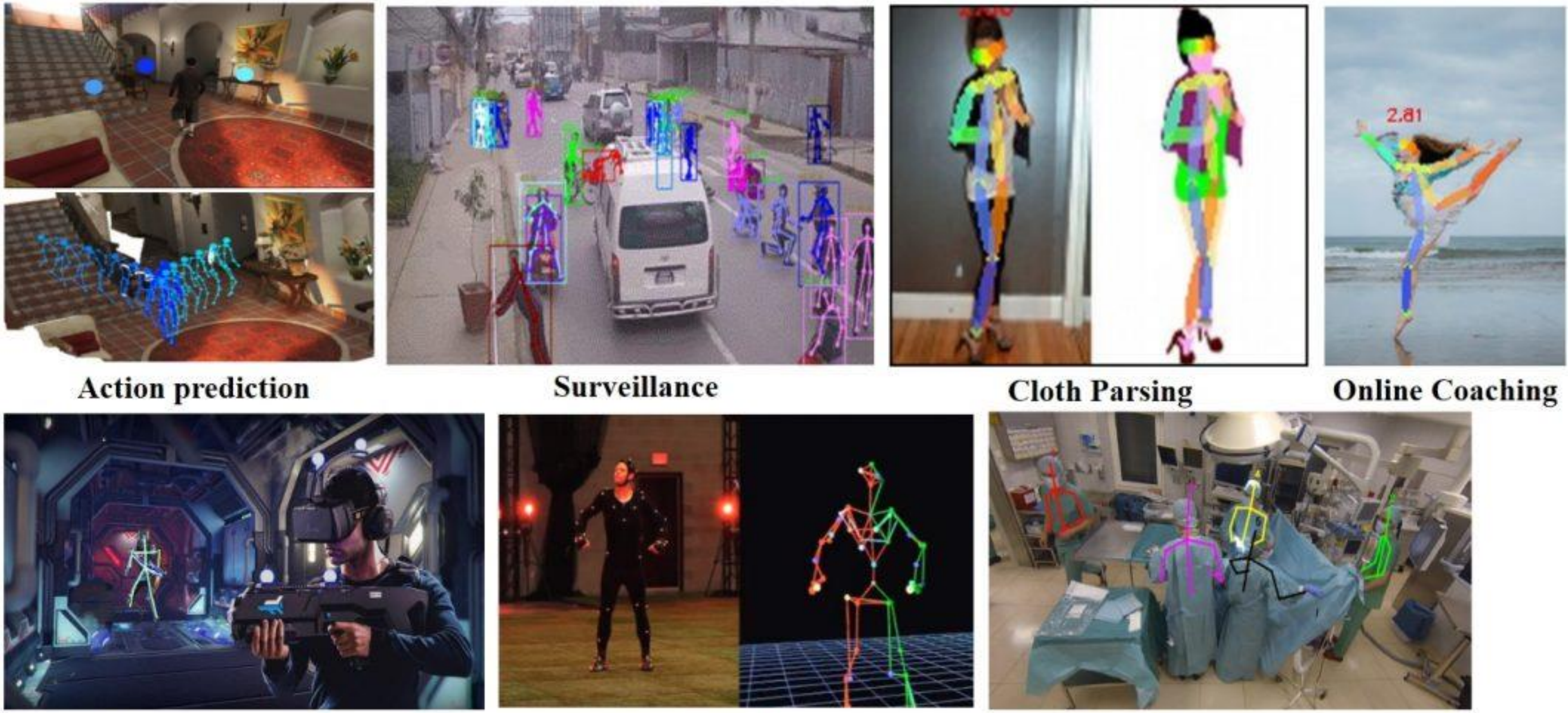


Landmarks

0. Nose
1. Left_eye_inner
2. Left_eye
3. Left_eye_outer
4. Right_eye_inner
5. Right_eye
6. Right_eye_outer
7. Left_ear
8. Right_ear
9. Left_mouth
10. Right_mouth
11. Left_shoulder
12. Right_shoulder
13. Left_elbow
14. Right_elbow
15. Left_wrist
16. Right_wrist
17. Left_pinky
18. Right_pinky
19. Left_index
20. Right_index
21. Left_thumb
22. Right_thumb
23. Left_hip
24. Right_hip
25. Left_knee
26. Right_knee
27. Left_ankle
28. Right_ankle
29. Left_heel
30. Right_heel
31. Left_foot_index
32. Right_foot_index



https://developers.google.com/ml-kit/vision/pose-detection



Action prediction

Surveillance

Cloth Parsing

Online Coaching

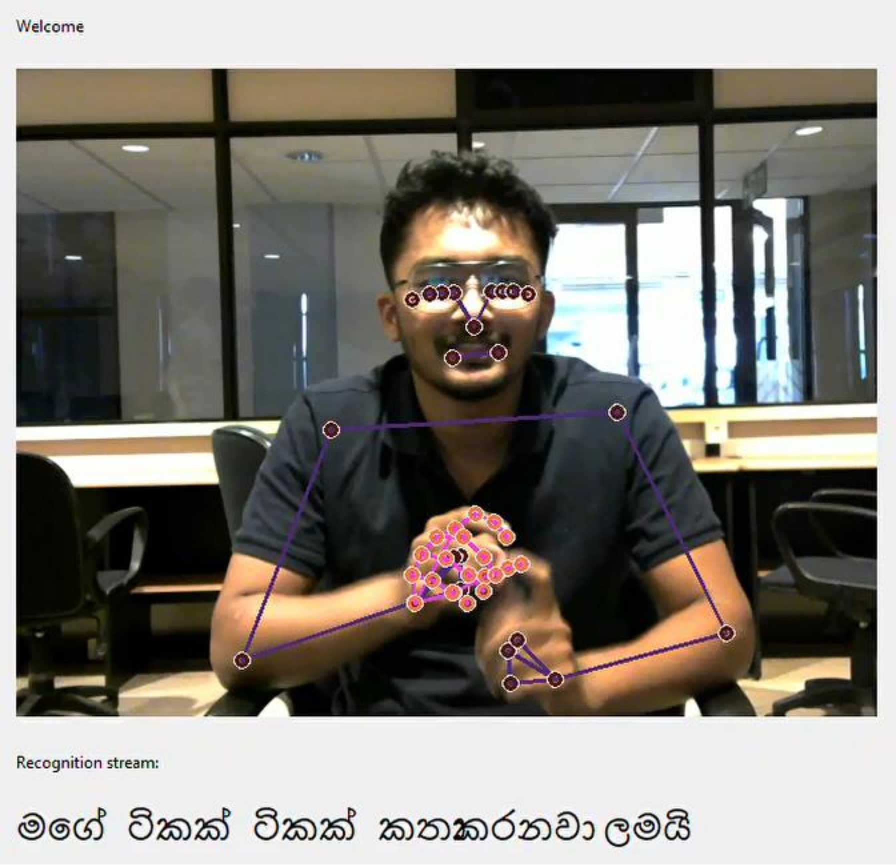
Movie and Game

AR and VR

Healthcare

https://arxiv.org/abs/2012.13392

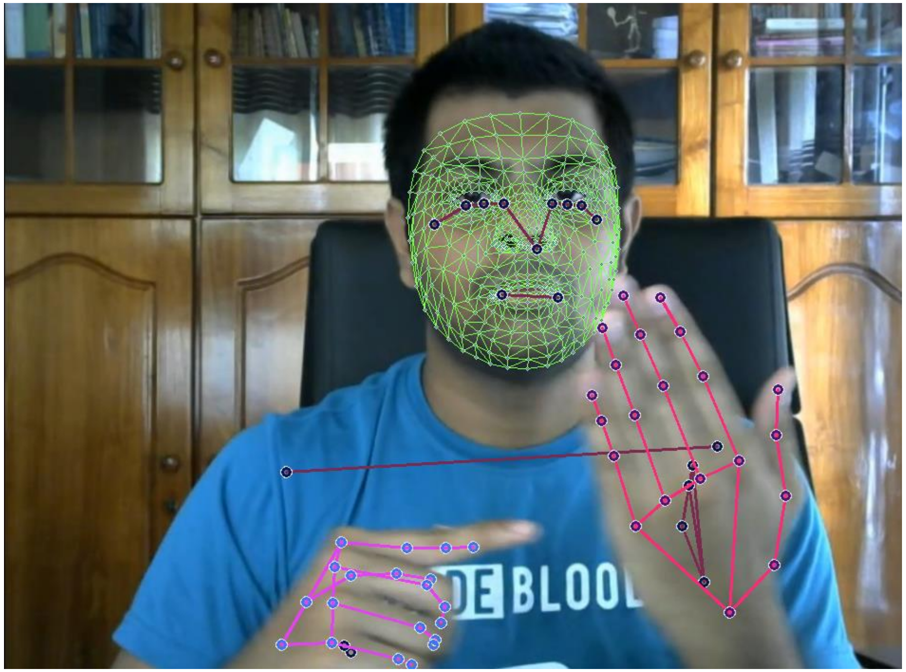
Project SigNoMeet



Welcome

Recognition stream:

මගේ ටිකක් ටිකක් කතාකරනවා ළමයි

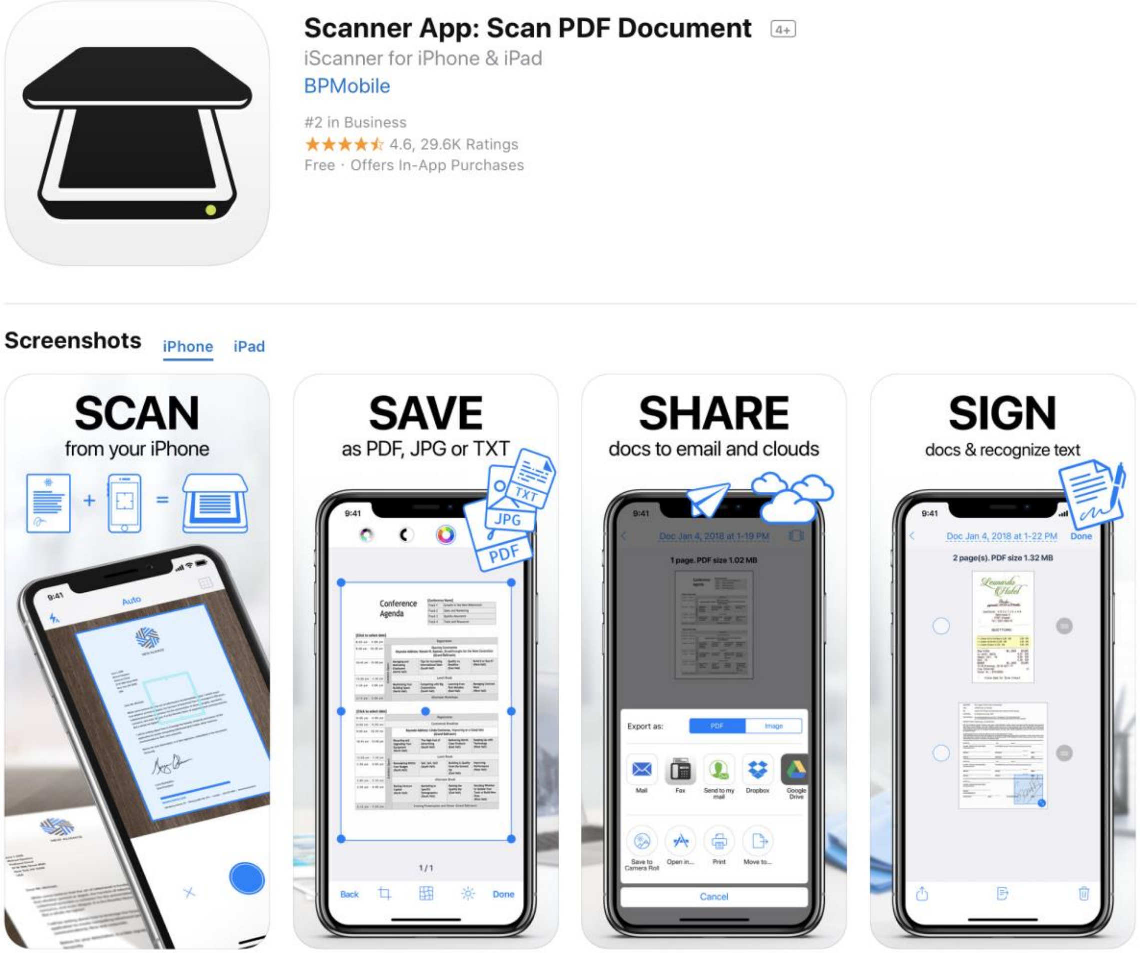


Beyond photos and videos – ML KIT

- Text recognition v2
- Image labeling
- Digital ink recognition
- Selfie segmentation

Beyond photos and videos - Examples

– Document scanning apps



Scanner App: Scan PDF Document 4+

iScanner for iPhone & iPad

BPMobile

#2 in Business

★★★★½ 4.6, 29.6K Ratings

Free · Offers In-App Purchases

Screenshots iPhone iPad

SCAN from your iPhone

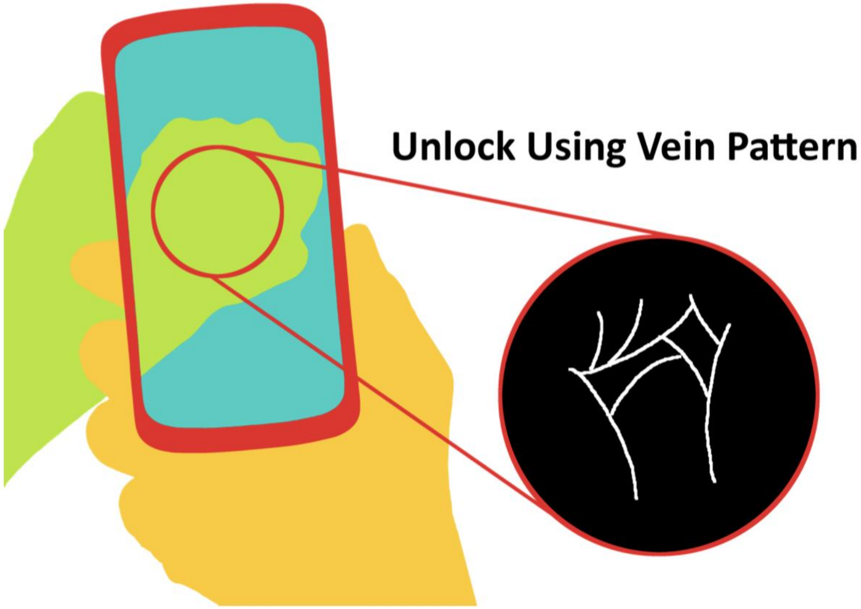
SAVE as PDF, JPG or TXT

SHARE docs to email and clouds

SIGN docs & recognize text

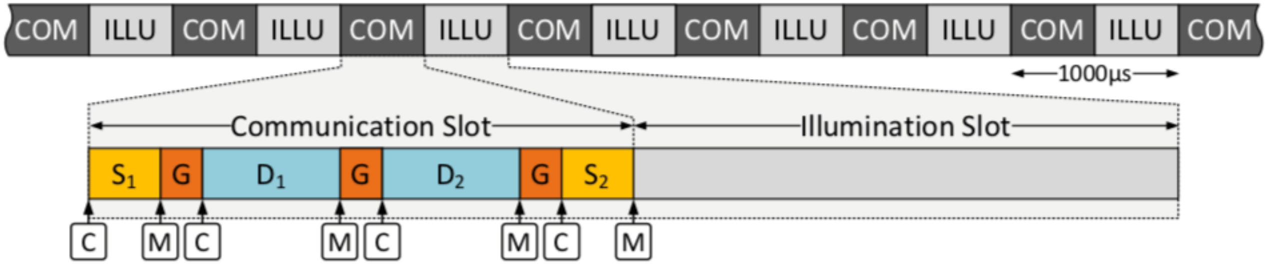
Beyond photos and videos - Examples

- VeinDeep – use vein patterns of your hand for authentication
- Zhong, Henry, Salil S. Kanhere, and Chun Tung Chou. "VeinDeep: Smartphone unlock using vein patterns." *Pervasive Computing and Communications (PerCom), 2017 IEEE International Conference on*. IEEE, 2017.



Beyond photos and videos - Examples

- Visible light communication
  - Stefan Schmid, Linard Arquint, and Thomas R. Gross. 2016. Using smartphones as continuous receivers in a visible light communication system. In Proceedings of the 3rd Workshop on Visible Light Communication Systems (VLCS '16). ACM, New York, NY, USA, 61-66.



Augmented Reality

- How augmented reality works
- Augmented reality creates an immersive experience for all its users. Though the most common AR forms are through glasses or a camera lens, interest in AR is growing, and businesses are showcasing more types of lenses and hardware through the marketplace. There are five significant components of AR:

1. Artificial intelligence. Most augmented reality solutions need artificial intelligence (AI) to work, allowing users to complete actions using voice prompts. AI can also help process information for your AR application.
2. AR software. These are the tools and applications used to access AR. Some businesses can create their own form of AR software.
3. Processing. You'll need processing power for your AR technology to work, generally by leveraging your device's internal operating system.
4. Lenses. You'll need a lens or image platform to view your content or images. The better quality your screen is, the more realistic your image will appear.
5. Sensors. AR systems need to digest data about their environment to align the real and digital worlds. When your camera captures information, it sends it through software for processing.

Mobile Augmented Reality

- Many AR SDKs
  - Apple's ARKit - https://developer.apple.com/arkit/
  - Google's ARCore - https://developers.google.com/ar/discover/
  - Wikitude - https://www.wikitude.com/

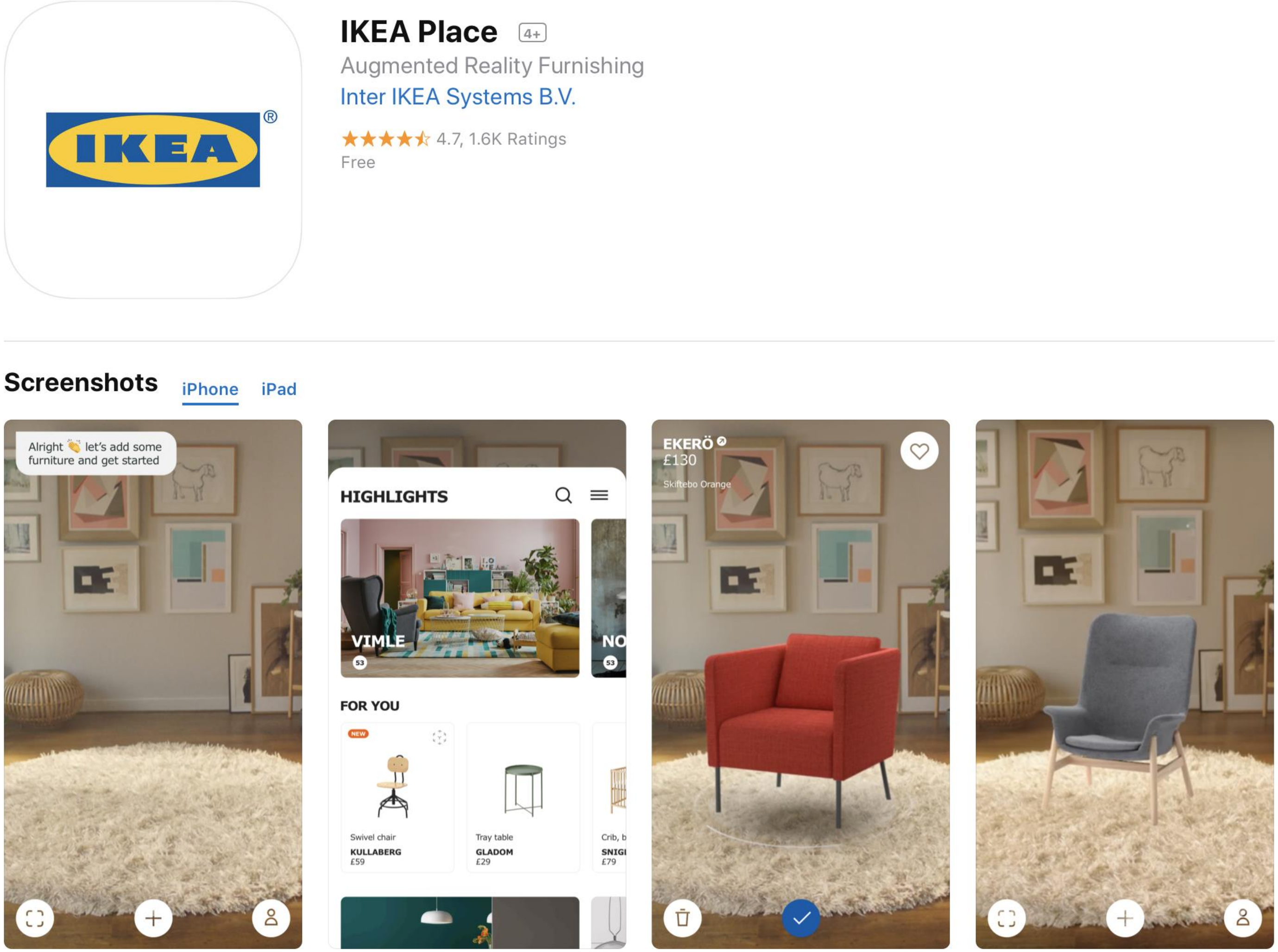
- Cross-platform development – Unity
  - https://unity.com/solutions/mobile-ar

Victoria Theatre & Concert Hall

Beyond photos and videos - Examples

- Live Texturing of Augmented Reality Characters from Colored Drawings

Beyond photos and videos - Examples



IKEA Place 4+

Augmented Reality Furnishing

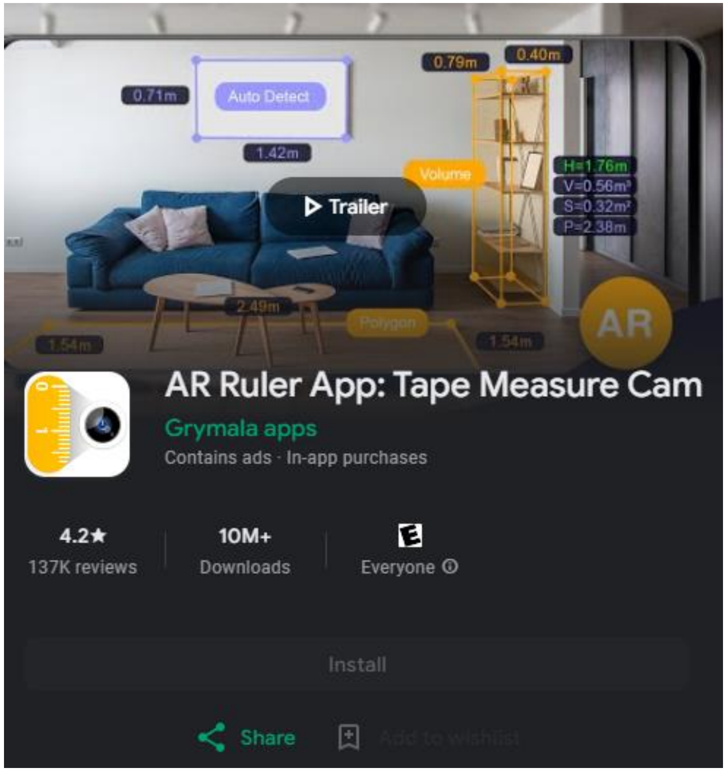
Inter IKEA Systems B.V.

★★★★☆ 4.7, 1.6K Ratings

Free

Screenshots iPhone iPad

Beyond photos and videos



AR Ruler App: Tape Measure Cam

Grymala apps

Contains ads · In-app purchases

4.2★ 137K reviews

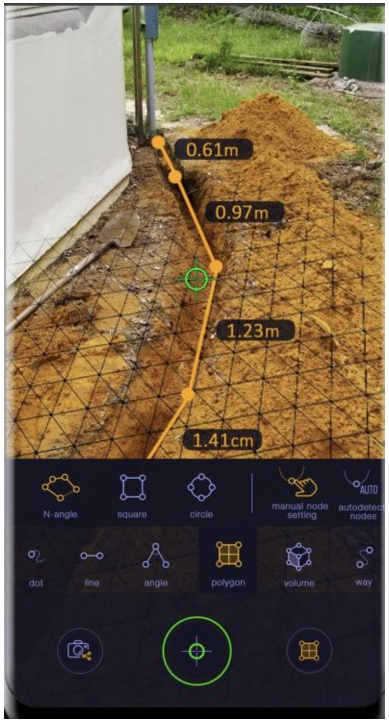
10M+ Downloads

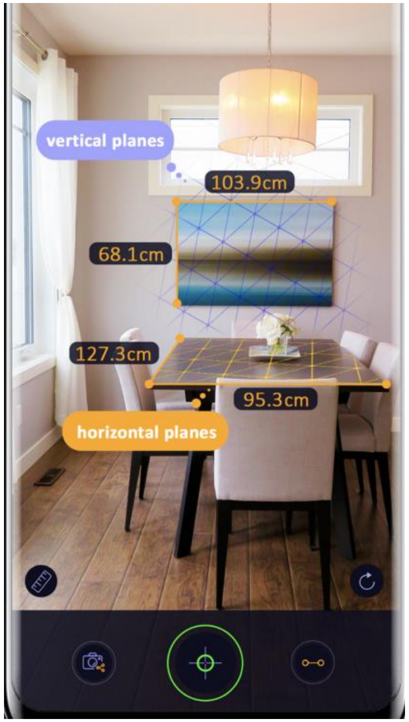
Everyone ⓘ

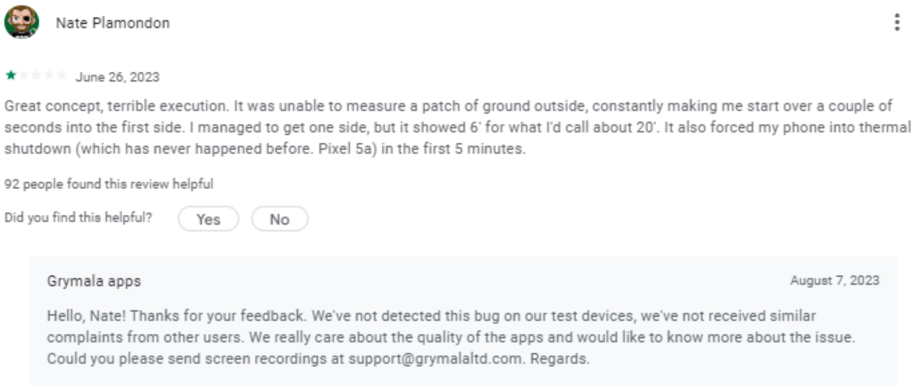
Install

Share

Add to wishlist







Nate Plamondon

★☆☆☆☆ June 26, 2023

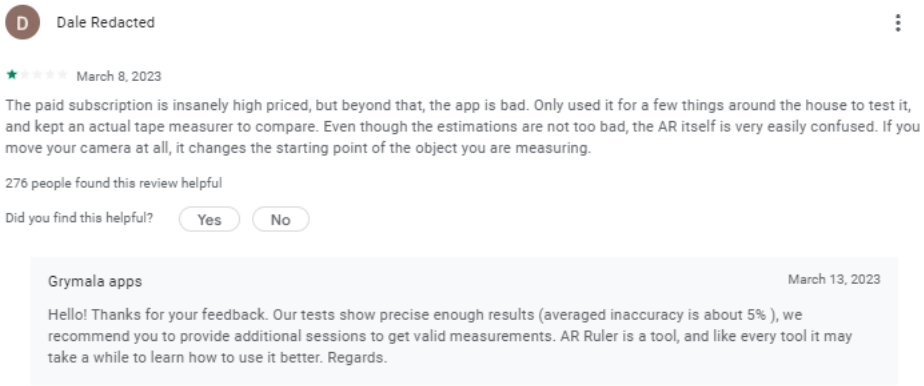
Great concept, terrible execution. It was unable to measure a patch of ground outside, constantly making me start over a couple of seconds into the first side. I managed to get one side, but it showed 6' for what I'd call about 20'. It also forced my phone into thermal shutdown (which has never happened before. Pixel 5a) in the first 5 minutes.

92 people found this review helpful

Did you find this helpful?

Grymala apps August 7, 2023

Hello, Nate! Thanks for your feedback. We've not detected this bug on our test devices, we've not received similar complaints from other users. We really care about the quality of the apps and would like to know more about the issue. Could you please send screen recordings at support@grymalaltd.com. Regards.



Dale Redacted

★☆☆☆☆ March 8, 2023

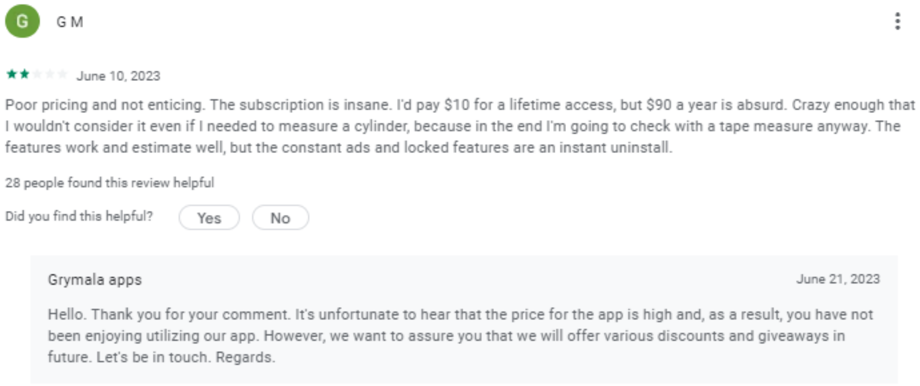
The paid subscription is insanely high priced, but beyond that, the app is bad. Only used it for a few things around the house to test it, and kept an actual tape measurer to compare. Even though the estimations are not too bad, the AR itself is very easily confused. If you move your camera at all, it changes the starting point of the object you are measuring.

276 people found this review helpful

Did you find this helpful?

Grymala apps March 13, 2023

Hello! Thanks for your feedback. Our tests show precise enough results (averaged inaccuracy is about 5%), we recommend you to provide additional sessions to get valid measurements. AR Ruler is a tool, and like every tool it may take a while to learn how to use it better. Regards.



G M

★★☆☆☆ June 10, 2023

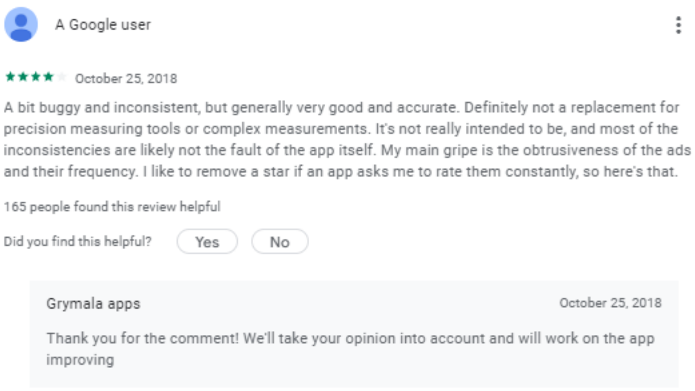
Poor pricing and not enticing. The subscription is insane. I'd pay $10 for a lifetime access, but $90 a year is absurd. Crazy enough that I wouldn't consider it even if I needed to measure a cylinder, because in the end I'm going to check with a tape measure anyway. The features work and estimate well, but the constant ads and locked features are an instant uninstall.

28 people found this review helpful

Did you find this helpful?

Grymala apps June 21, 2023

Hello. Thank you for your comment. It's unfortunate to hear that the price for the app is high and, as a result, you have not been enjoying utilizing our app. However, we want to assure you that we will offer various discounts and giveaways in future. Let's be in touch. Regards.



A Google user

★★★★☆ October 25, 2018

A bit buggy and inconsistent, but generally very good and accurate. Definitely not a replacement for precision measuring tools or complex measurements. It's not really intended to be, and most of the inconsistencies are likely not the fault of the app itself. My main gripe is the obtrusiveness of the ads and their frequency. I like to remove a star if an app asks me to rate them constantly, so here's that.

165 people found this review helpful

Did you find this helpful?

Grymala apps October 25, 2018

Thank you for the comment! We'll take your opinion into account and will work on the app improving

Today's Takeaway

- **Smartphones are powerful.**
- Allows developers to come up with innovative applications.

- **How can we take advantage of capabilities of smartphones ?**
  - Can you solve the problem you found using these capabilities ?
  - Can you use these capabilities to improve a current solution ?
  - Can you exploit these capabilities for an innovative new app ?

Today's Takeaway

- **How can we take advantage of capabilities of smartphones ?**

- Homework Question: (solving an specific problem)
- You have one smart electric light and home WiFi. You want to switch-on your light when you move closer to the light (or a specific location). However, you do not have motion detection sensors with you. The developer of the smart electric light provides SDK to develop third party apps. How do you design a mobile app for this specific purpose ?

Today’s Takeaway

- **How can we take advantage of capabilities of smartphones ?**

- Example Question 2: (open-ended)
- You started a new company to sell small electronic items online. Smartphones can be used in numerous ways to enhance the efficiency of every business. How to do design an innovative mobile app to improve your productivity of your new business?

What’s Next ?

- Week 6: Challenges associated with mobile computing
- Reminder: Proposal is due next week !

- Happy Learning !