Sensors

```
Course Code: ELEE1146

Course Name: Mobile Applications for Engineers

Credits: 15

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```

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Sensors 101

- A sensor is any device that measures an event or change in an environment and transforms it into an electronic signal that can be read and computed.
- Measuring some phenomena
- Passive (require and external signal)
- Active (require an external signal)
- Analogue (produce an anlaogue output; ie a continous signal)
- Digital (work with discrete, digital data)

Android `SensorManager`

- The is an abstract class that extends the `Object` class.
- Lets you access the device's **sensors**
- `Sensor` are their own class that also extends `Object`
- `Sensor.getSensorList` gets you all the available sensors.
- `SensorEventListener` used for receiving notifications from the SensorManager when there is new sensor data.

Source Code

The source code is written in `C` and sits on the Linux Kernel that has been modified for the Android OS.

- https://android.googlesource.com/platform/hardware/libhardware/+/master/include/hardware/sensors.h

```
...
#define SENSOR_STRING_TYPE_ACCELEROMETER                "android.sensor.accelerometer"
#define SENSOR_STRING_TYPE_MAGNETIC_FIELD               "android.sensor.magnetic_field"
#define SENSOR_STRING_TYPE_ORIENTATION                  "android.sensor.orientation"
#define SENSOR_STRING_TYPE_GYROSCOPE                    "android.sensor.gyroscope"
#define SENSOR_STRING_TYPE_LIGHT                        "android.sensor.light"
#define SENSOR_STRING_TYPE_PRESSURE                     "android.sensor.pressure"
#define SENSOR_STRING_TYPE_TEMPERATURE                  "android.sensor.temperature"
...
```

Motion Sensors

The sensors' possible architectures vary by sensor type:

- **Software/Hardware**
  - Gravity,
  - linear acceleration,
  - rotation vector,
  - significant motion,
  - step counter,
  - step detector sensors
- **Hardware Only**
  - accelerometer
  - gyroscope
  - gy

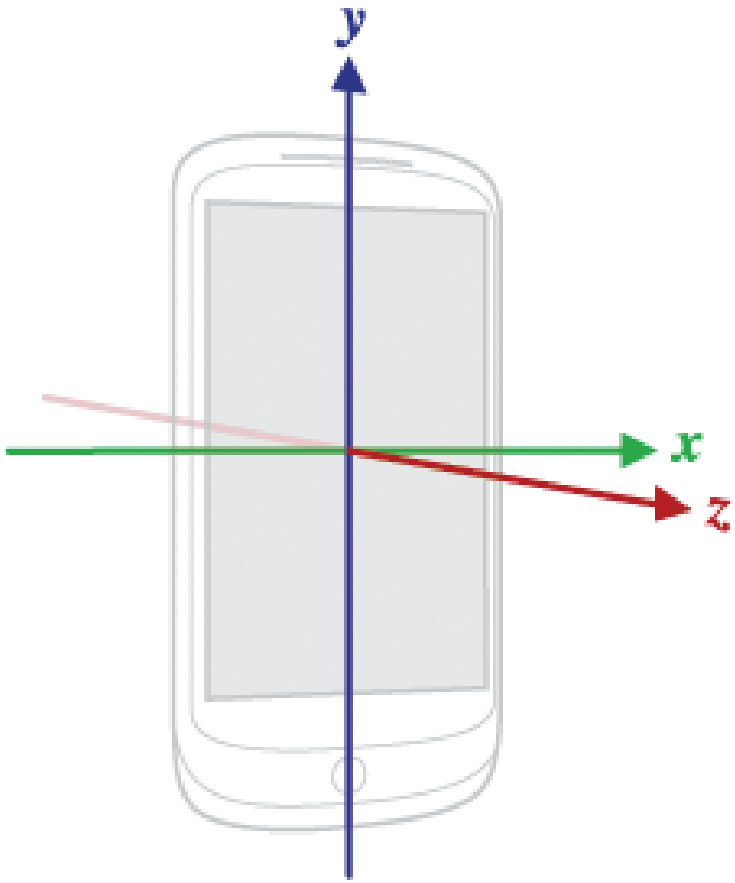
Motion Examples

`TYPE_STEP_COUNTER` is derived from `TYPE_ACCELEROMETER` via software

Sensor	Sensor event data	Description Units of measure	Type
`TYPE_ACCELEROMETER`	`SensorEvent.values[0]`	Acceleration force along the x axis (including gravity). $m/s2$	Hardware
	`SensorEvent.values[1]`	Acceleration force along the y axis (including gravity).	
	`SensorEvent.values[2]`	Acceleration force along the z axis (including gravity).	
`TYPE_STEP_COUNTER`	`SensorEvent.values[0]`	Number of steps taken by the user since the last reboot while the sensor was activated.Steps	Sofware

Position sensors

- Two sensors that let you determine the position of a device:
  - Geomagnetic field sensor
    - geomagnetic field strength values for each of the three coordinate axes during a single sensor event
  - Accelerometer (we have seen this before)
    - measures the acceleration applied to the device during a sensor event



Position Examples

Sensor	Sensor event data	Description	Units
`TYPE_GEOMAGNETIC_ROTATION_VECTOR`	`SensorEvent.values[0]`	Rotation vector x axis ($x * sin(\frac{\theta}{2})$).	Unitless
	`SensorEvent.values[1]`	Rotation vector y axis ($y * sin(\frac{\theta}{2})$)	
	`SensorEvent.values[2]`	Rotation vector z axis ($z * sin(\frac{\theta}{2})$)	
`TYPE_MAGNETIC_FIELD`	`SensorEvent.values[0]`	Geomagnetic field strength along the x axis.	μT
	`SensorEvent.values[1]`	Geomagnetic field strength along the y axis	
	`SensorEvent.values[2]`	Geomagnetic field strength along the z axis	

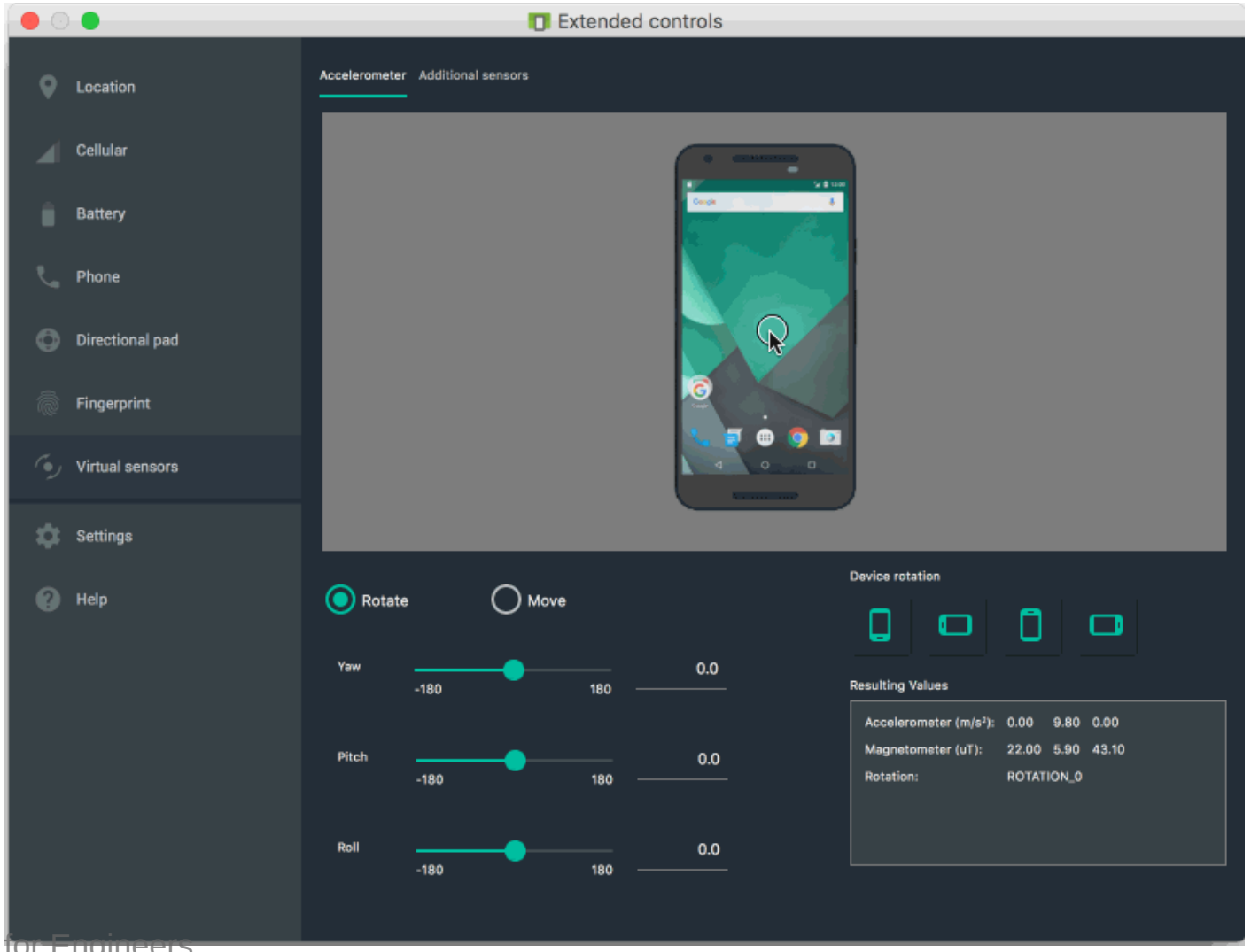
Environment Sensors

- Four sensors that let you monitor various environmental properties:
  - Tempeature
  - Humidity
  - Pressure
  - light
- All hardware based sensors and are available only if a device manufacturer has built them into a device.
  - Exception is the light sensor which used to control screen brightness

Environment Examples

Sensor	Sensor event data	Units of measure	Data description
`TYPE_AMBIENT_TEMPERATURE`	`event.values[0]`	°C	Ambient air temperature.
`TYPE_LIGHT`	`event.values[0]`	lx	Illuminance
`TYPE_PRESSURE`	`event.values[0]`	hPa or mbar	Ambient air pressure.
`TYPE_RELATIVE_HUMIDITY`	`event.values[0]`	%	Ambient relative humidity.
`TYPE_TEMPERATURE`	`event.values[0]`	°C	Device temperature

Sensors - Emulator Extended Controls

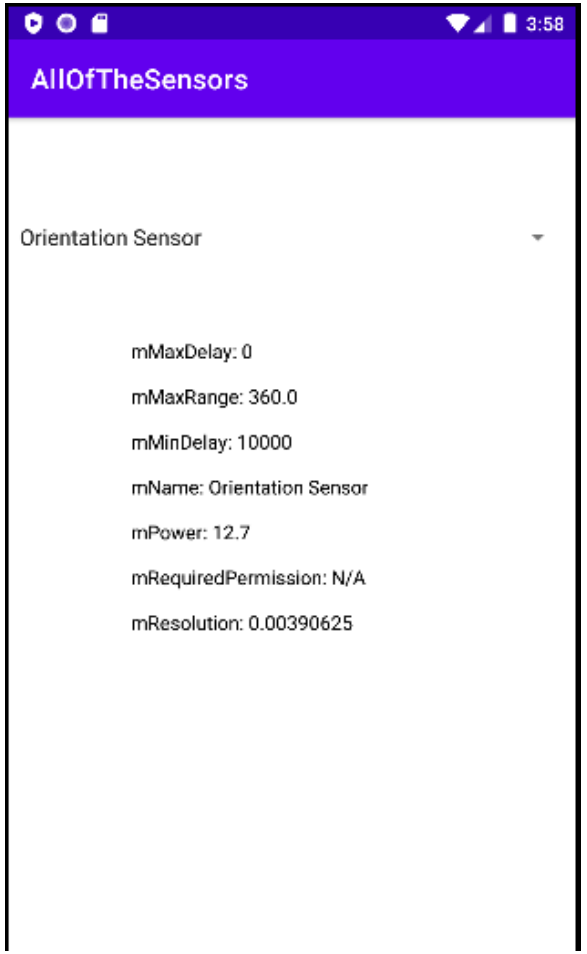


`Sensor` `Field`'s

- There are numerous variables that provide information about a sensor.
- accessible through functions like...

```
fun getFifoReservedEventCount(): Int {
return android.hardware.Sensor.mFifoMaxEventCount
}
```

In the lab will be using Fields to always get the same data from each sensor



`StringBuilder` Class

- a **mutable** sequence of characters.
- `String` Class in Java creates an **immutable** sequence of characters,
- Constructs a string builder with no characters in it and an initial capacity of 16 characters

```
val stringBuilder = StringBuilder()

stringBuilder.append("Hello");
stringBuilder.append("World!");
// print string
println("String = " + str.toString());
```

▶ Output?

`Pattern` Class

- is class used in regular expression(regex)
- is a type of object that is used to help you extract information from any string data by searching through text to find what you need
- you will with high probabilty encounter regex many times in your career and by then this daunting set of characters grouped together will be a breeze:

```
(\b[A-Z][a-z]*\s*\b)+$
```

▶ Means?

`Pattern` Class

```
val pattern = Pattern.compile("^(.+)@example.com$")

// Input list
val emails = listOf("anemail@example.com", "whouses@yahoo.com",
                    "sellout@google.com", "youremail@example.com")

for (email in emails) {
    val matcher = pattern.matcher(email)

    if (matcher.matches()) {
        println(email)
    }
}
```

- Output?