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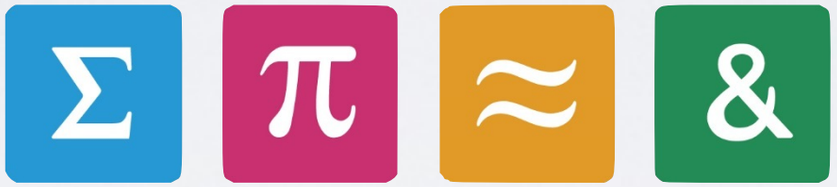

Kart Remote Programming

Christopher Metrailler | Patrice Rudaz | Michael Clausen

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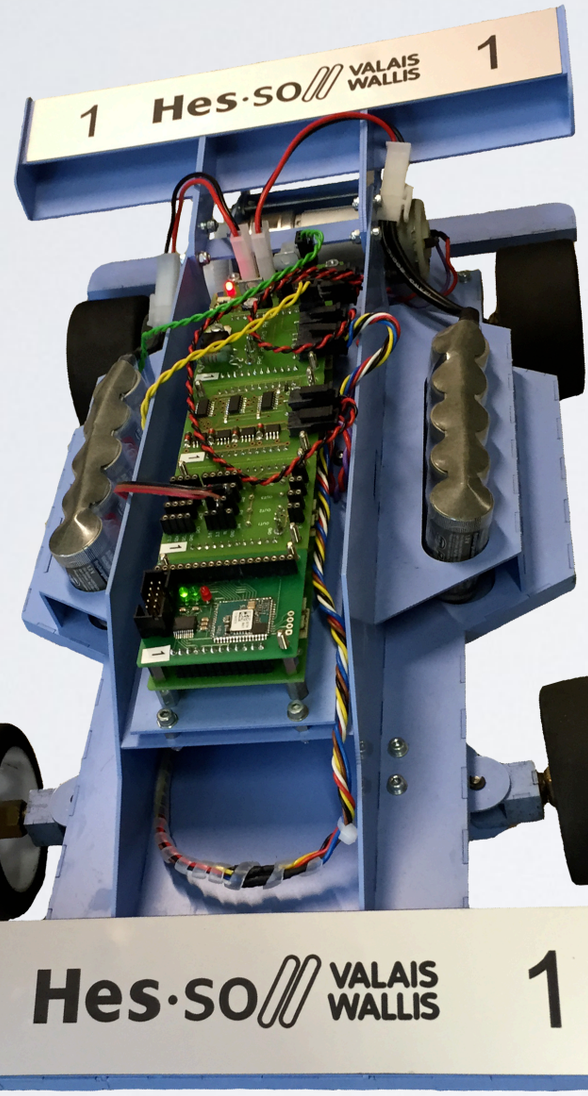

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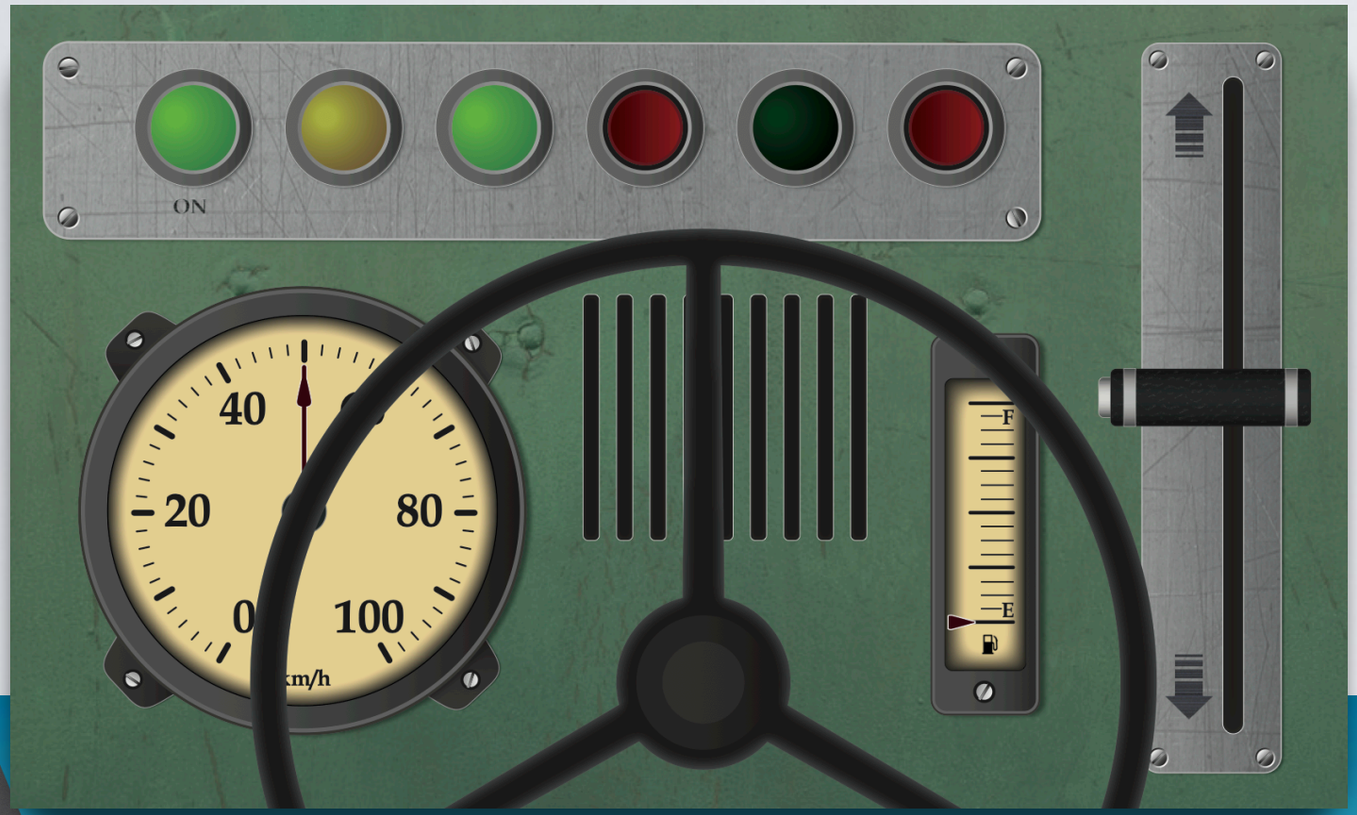


Battery Level

Steering position

SETTINGS

LED 1 LED 2 LED 3 LED 4

FORWARD

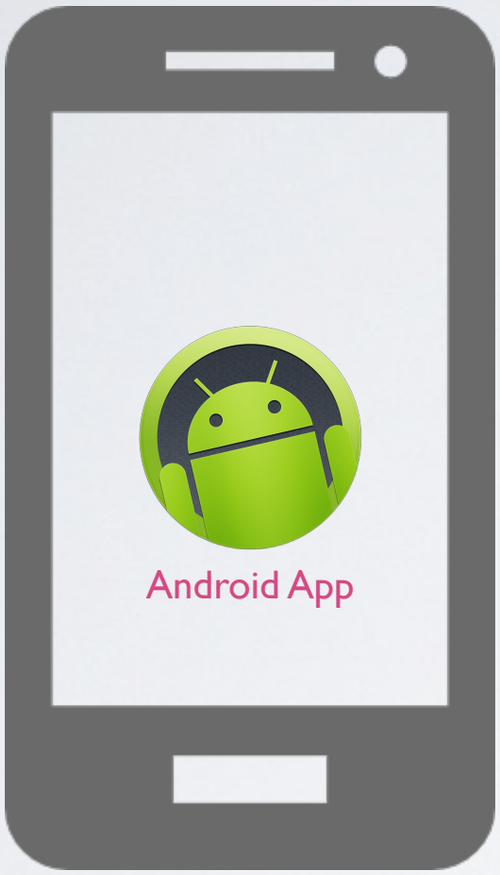
BACKWARD

TURN LEFT TURN RIGHT

Goals

Use basic elements seen in INF I course.

Goals



Galaxy Nexus

Bluetooth

Kart

Hardware

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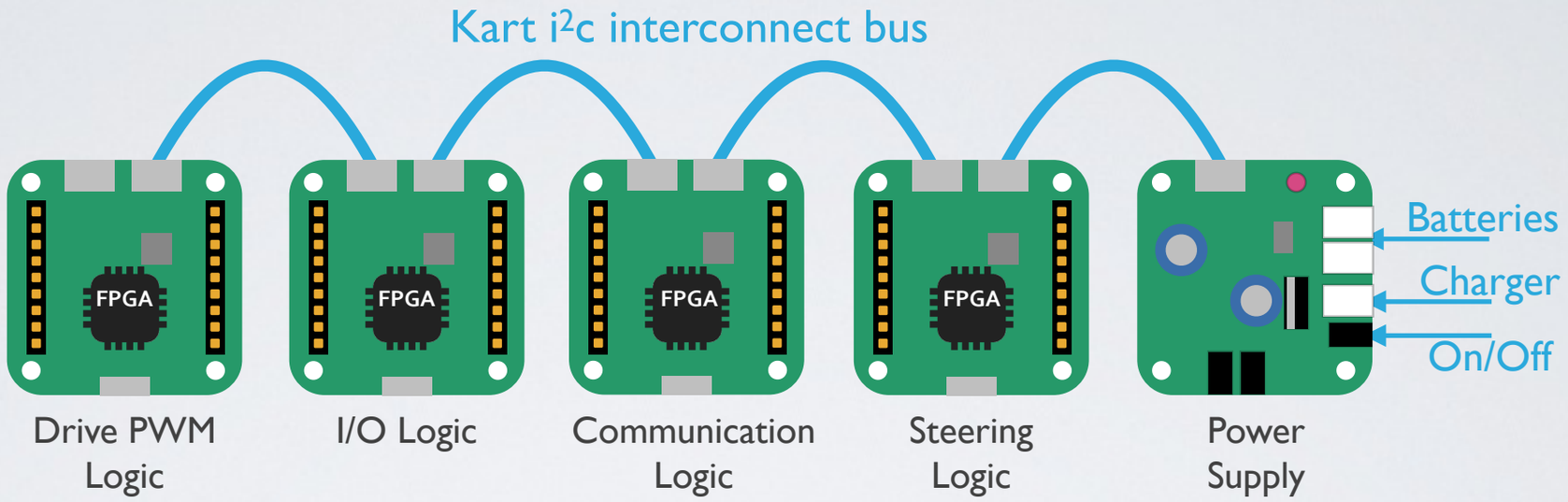

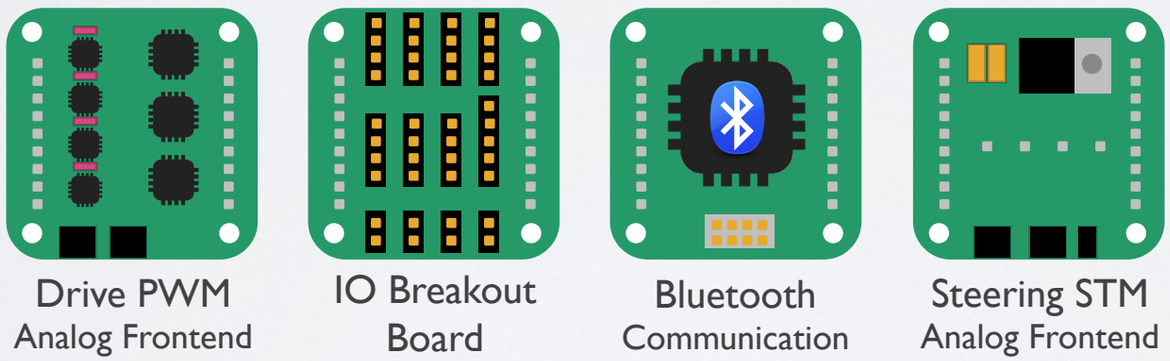

Hardware (2)

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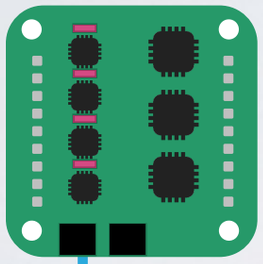
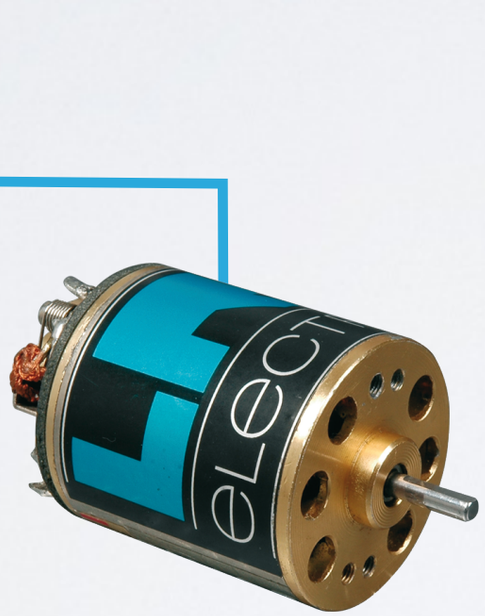
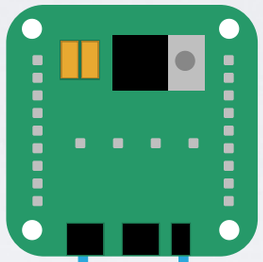
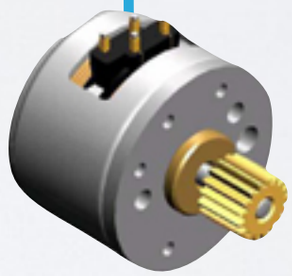




Drive motor





Stepper motor

Limit switch

Hardware (3)

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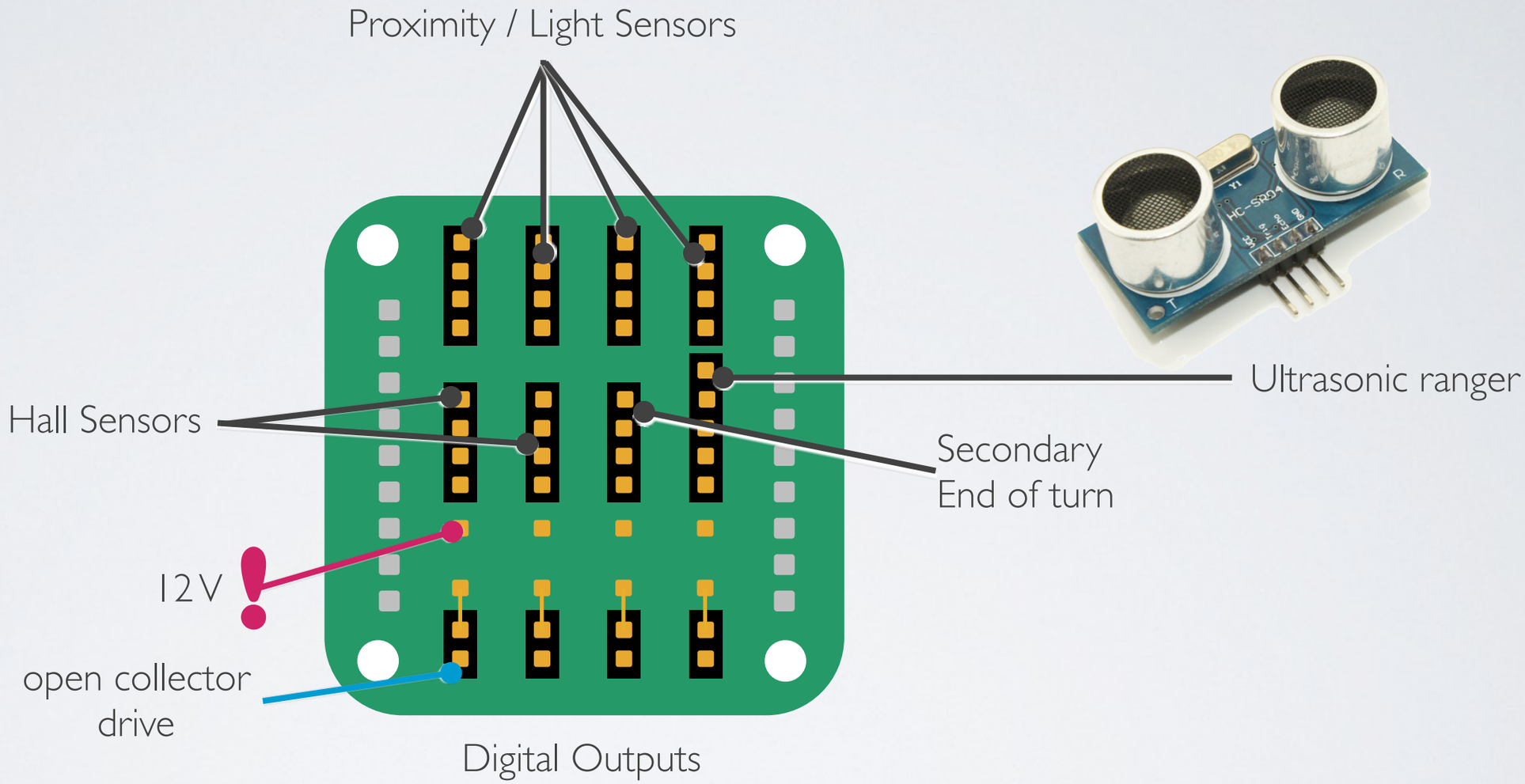

Remote Control Protocol

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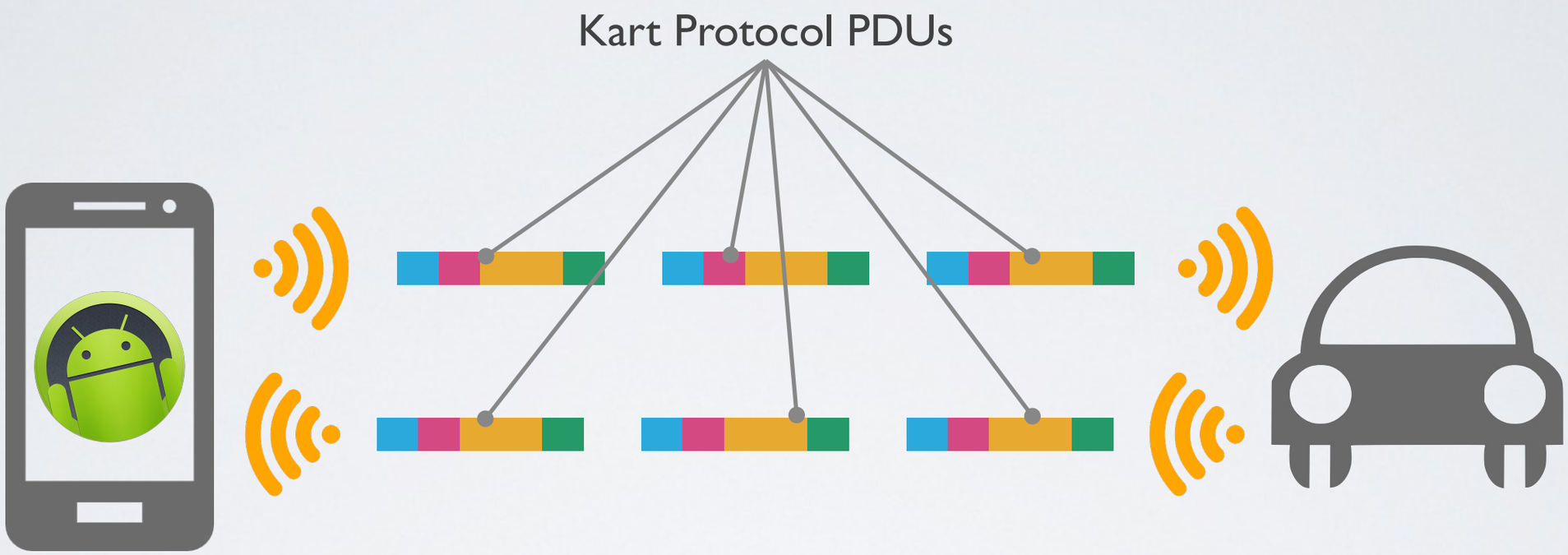

Remote Control Protocol

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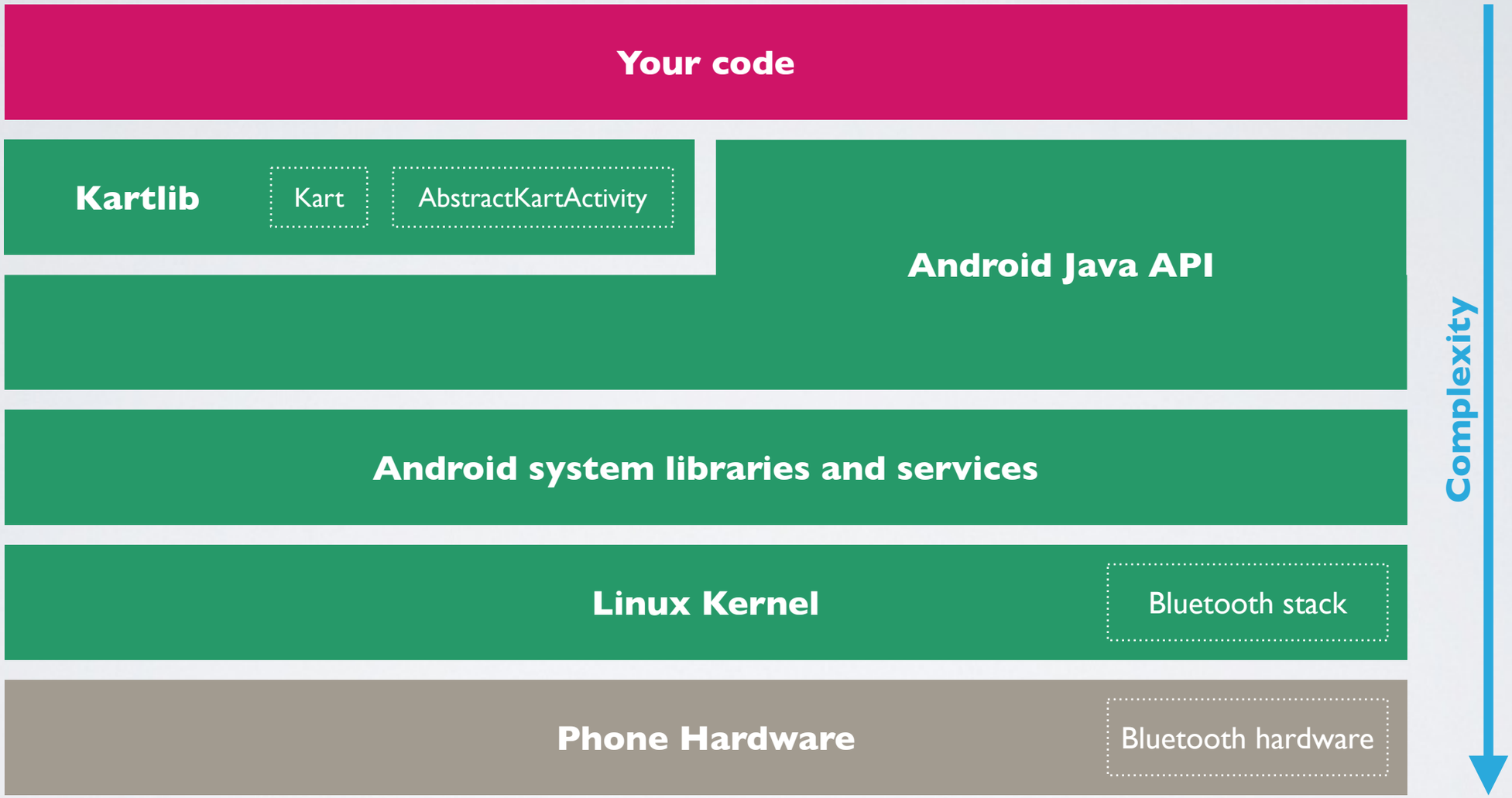

Remote Control Android App

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Android

- Mobile **O**perating **S**ystem developed by **Alphabet** (Google).
- **Abstracts hardware** from different manufacturers to a **common API**
- Applications are written in **Java or Kotlin** and run on a **Virtual Machine** (Dalvik or ART)
- Android is **open source**, based on **Linux**.
- The **SDK** & **Android Studio** (based on **IntelliJ IDEA**) are free to use and allow everyone to build applications for Android.

Android

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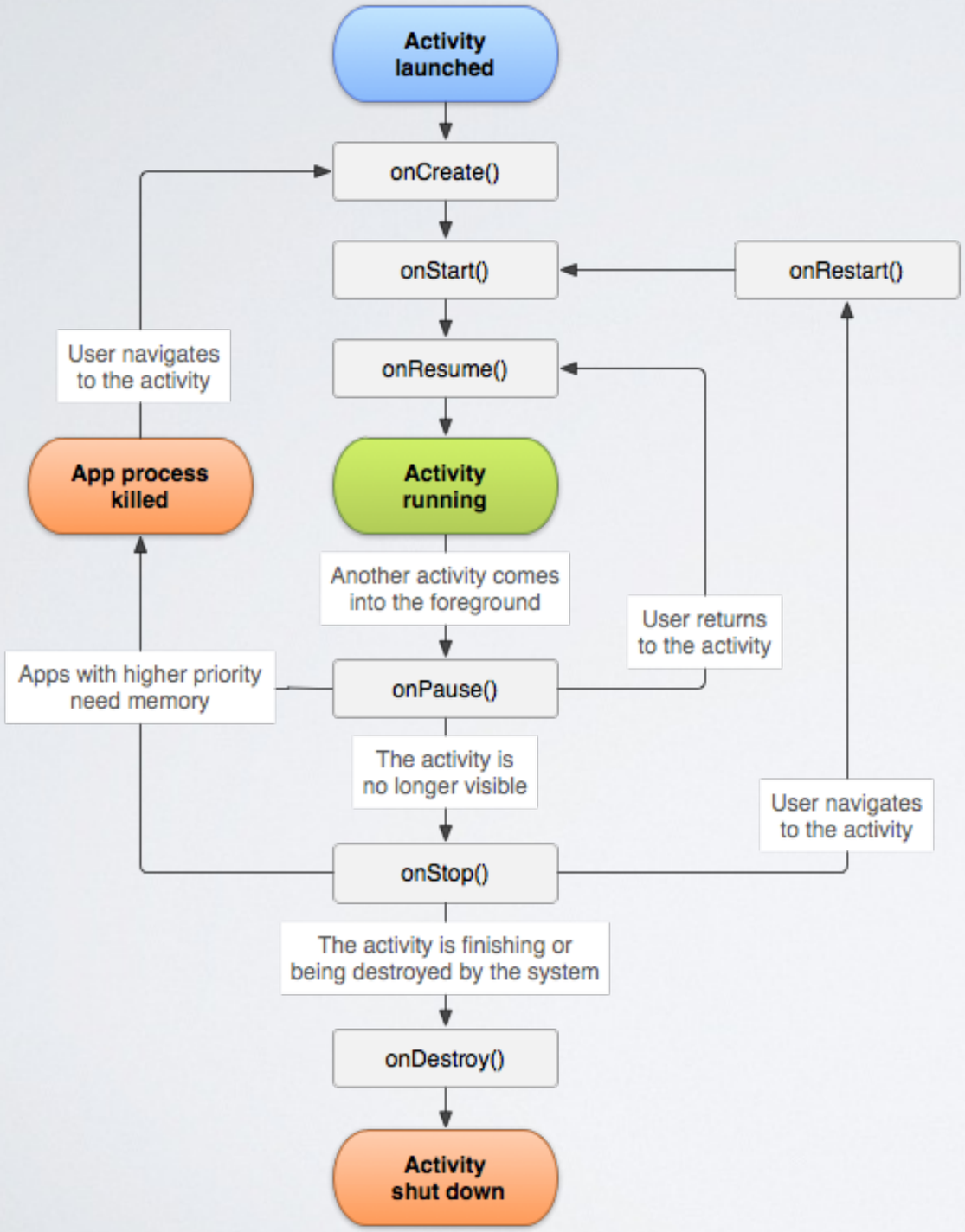
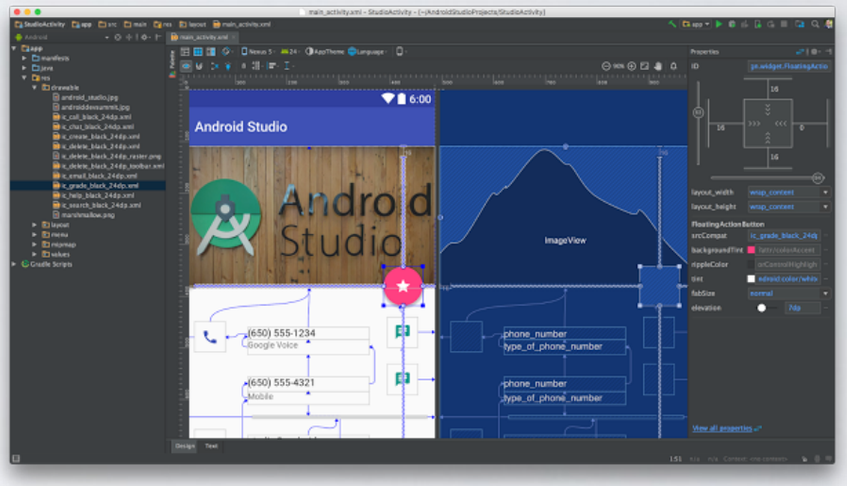
Android Application lifecycle



Layouts



- UI layouts can be designed using an editor integrated into Android Studio.
  - Layouts are serialized to XML files.
  - Those Layouts can be loaded in code.

Remote Control Android App

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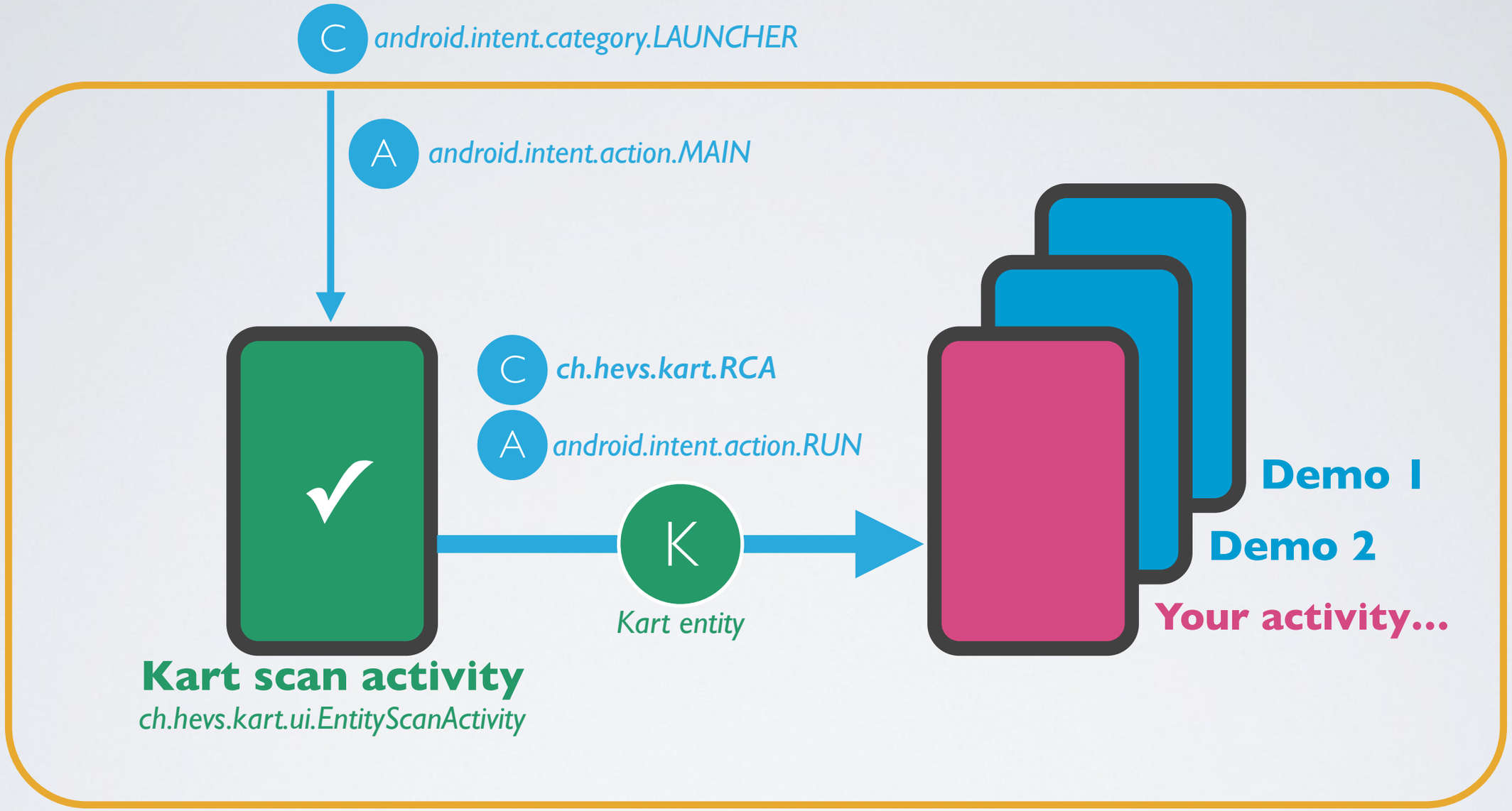

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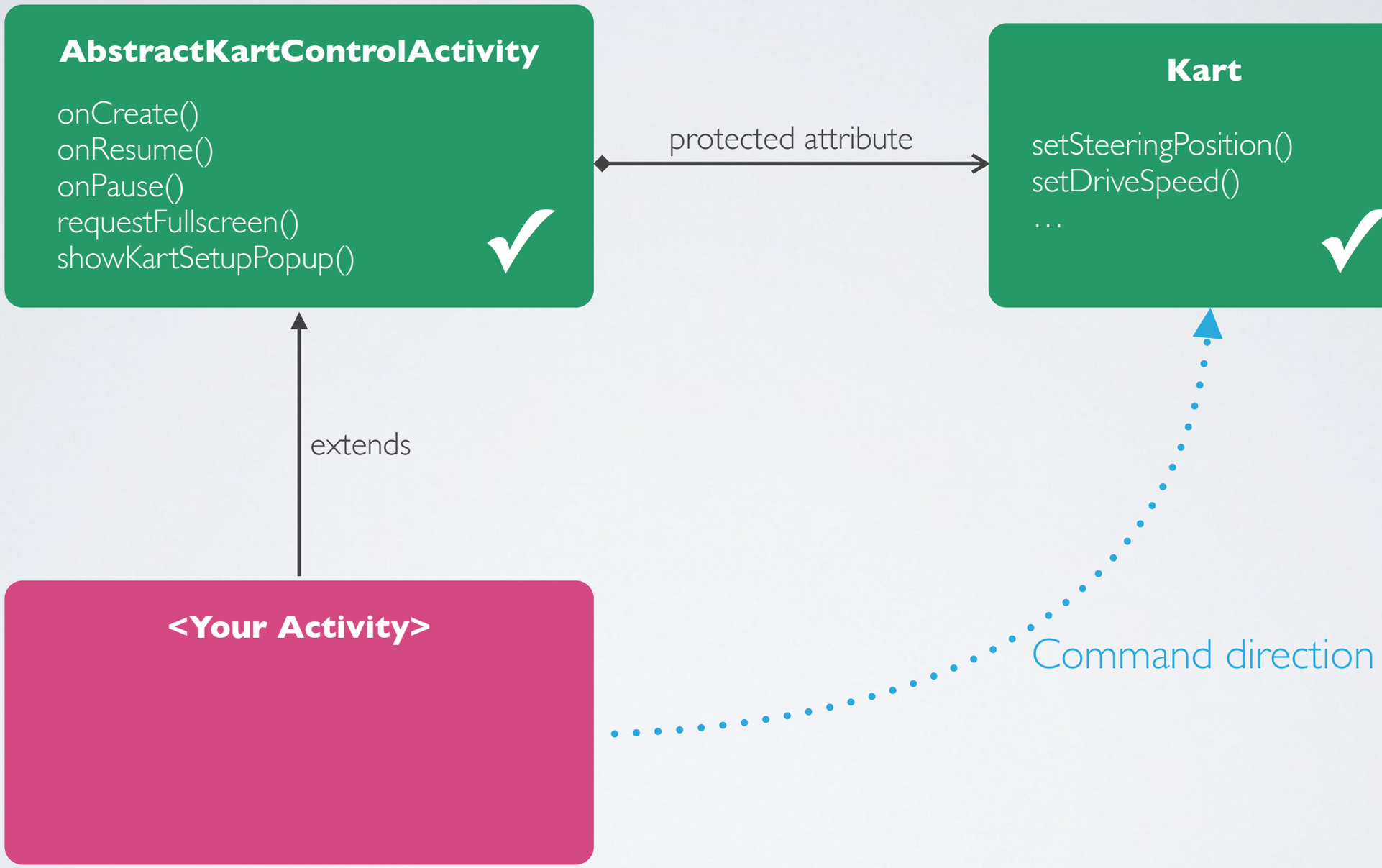

Remote Control Android App

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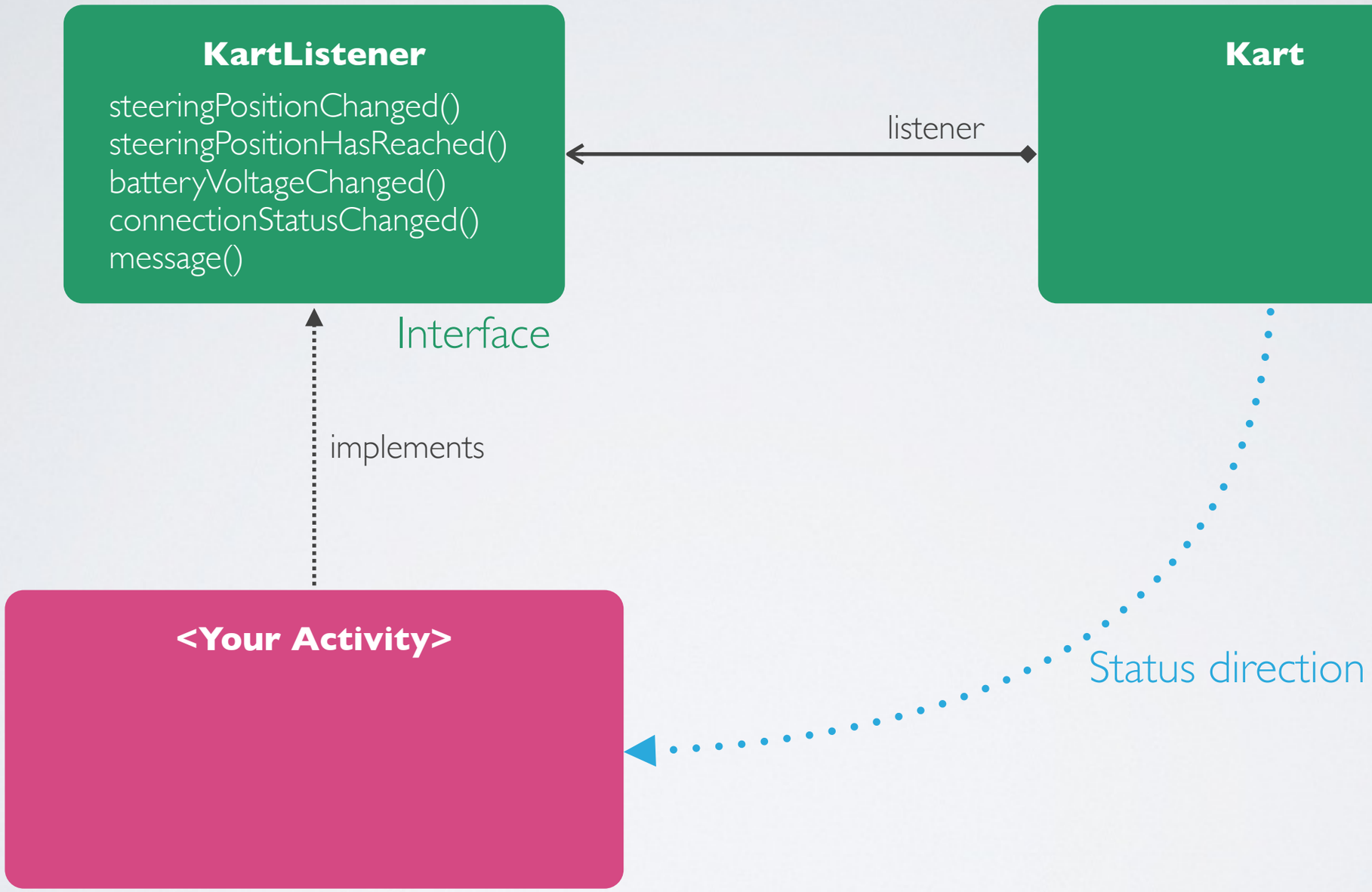

Remote Control Android App

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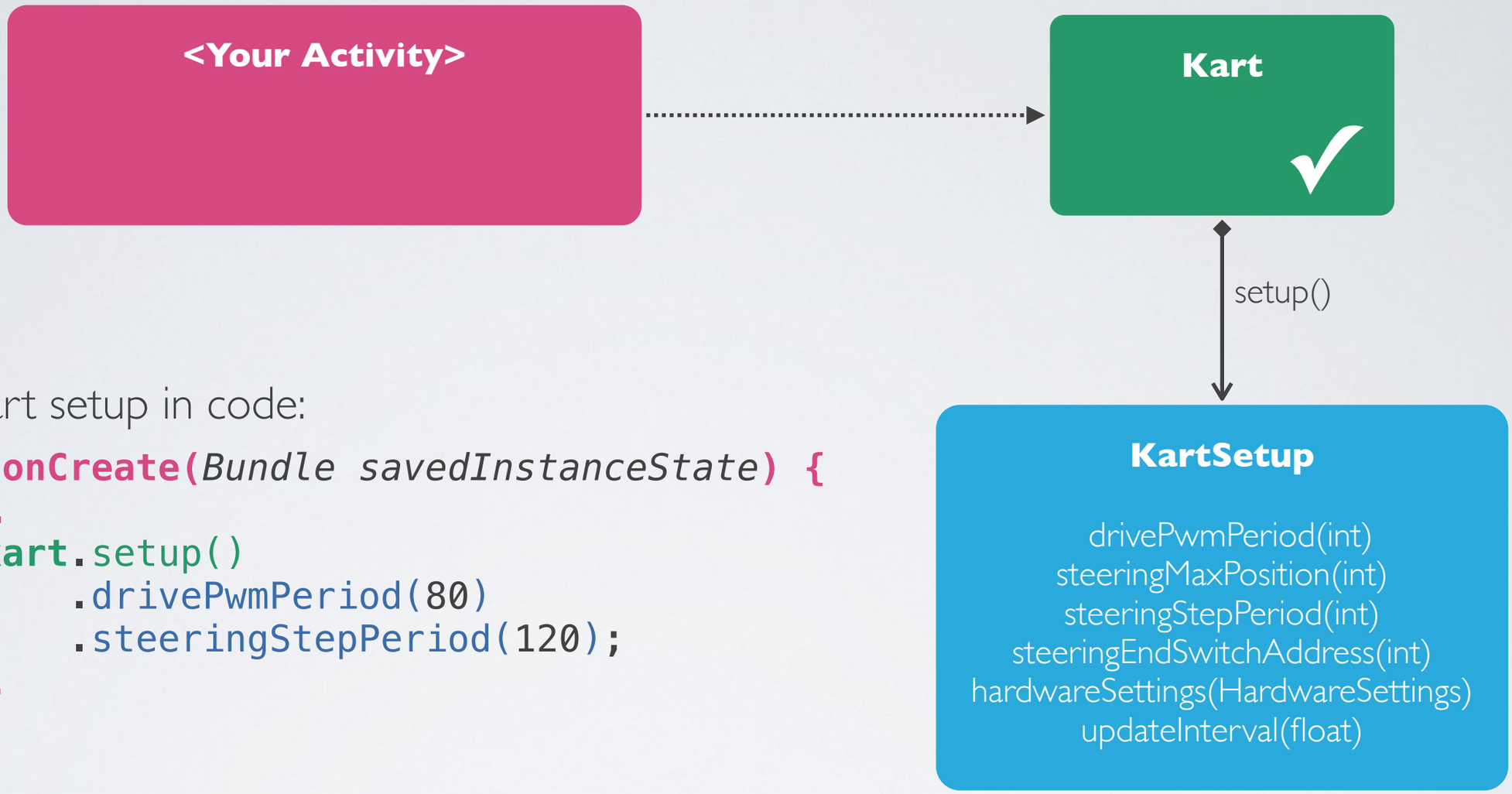

Manual kart setup in code:

```
void onCreate(Bundle savedInstanceState) {
    …
    kart.setup()
        .drivePwmPeriod(80)
        .steeringStepPeriod(120);
    …
}
```

Using the provided kart setup UI:

```
void onCreate(Bundle savedInstanceState) {
    …
    showKartSetupPopup();
    …
}
```

Software Goals

- **Slider control**
  - Direction
  - Speed
- **Progress Bar status**
  - Battery level
  - Steering position
- **Accelerometer (Orientation) control**
  - Button to enable orientation control
  - Device orientation controls sliders or kart

Software Grade

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Functional blackbox tests during morning of the last day

All mandatory features

Direction control
Speed control
Battery display
Direction display

→ 5.0

\+

0.25 ← **Per optional feature**

LED's
Ultrasound sensor
Proximity sensor
Hall sensor
Steering assistant
Other improvements

=

Grade

Android Studio

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1. **Download** the Kart project template from the wiki
2. **Extract** the archive to the **local** disk
3. **Open** the extracted folder in Android Studio

Android Studio

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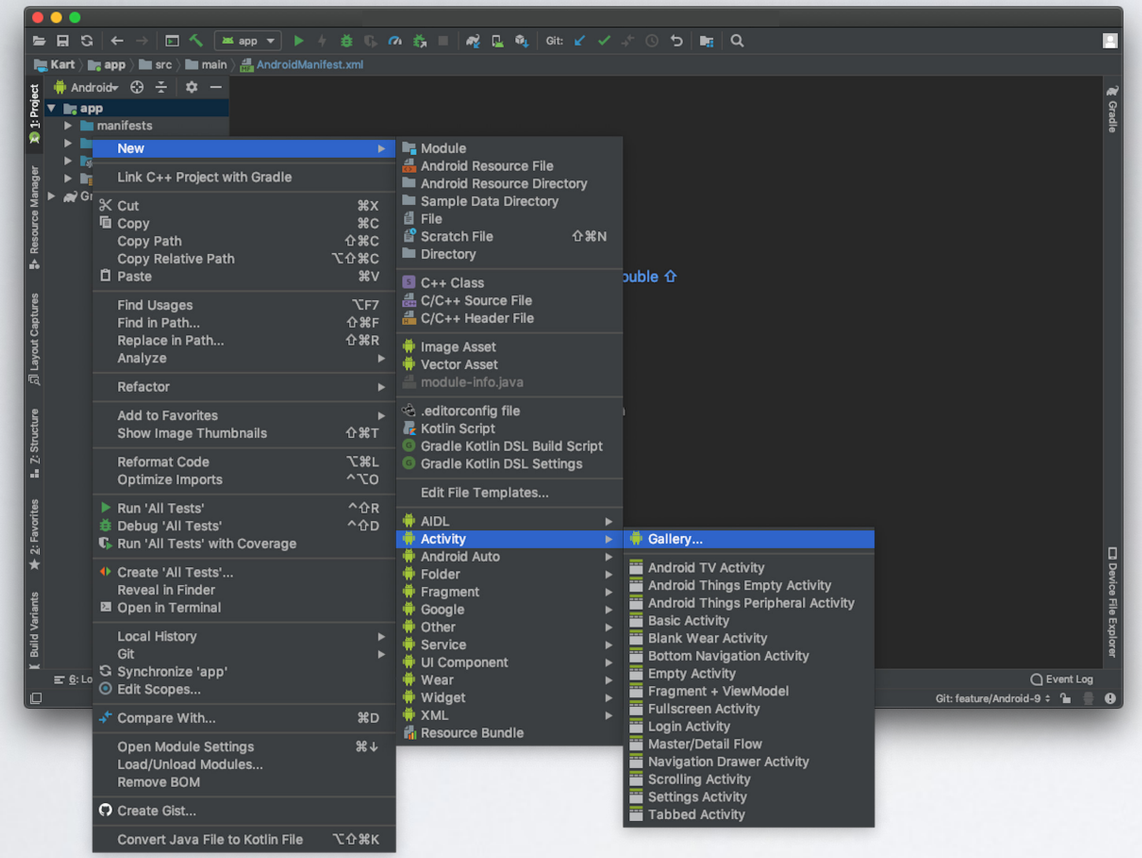
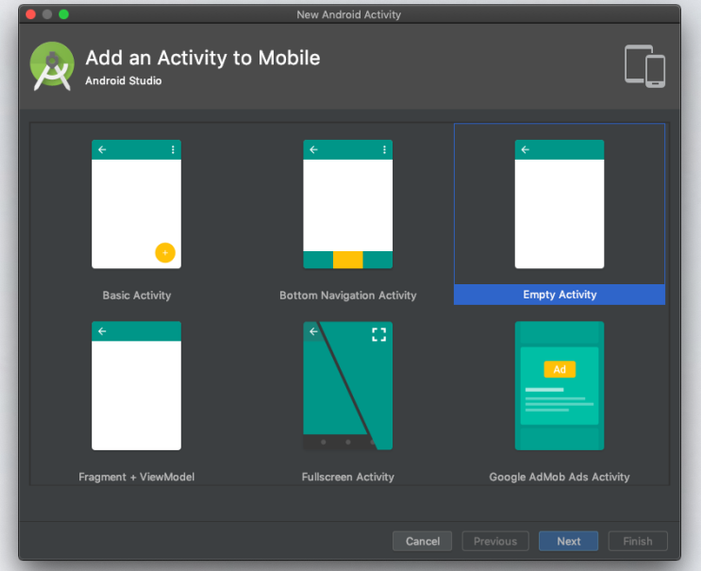
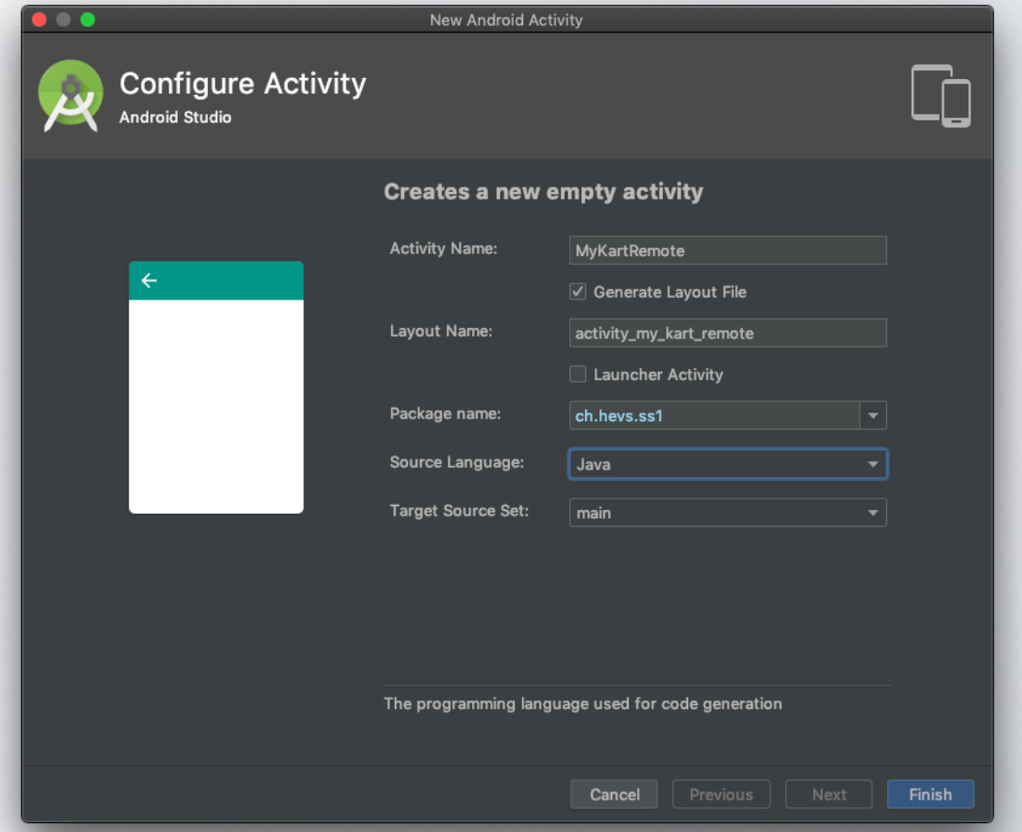
4 Select New > Activity > Gallery…



5 Select Empty Activity



6 Configure Activity



Android Studio

7 Modify **Activity Java code**

```java
package ch.hevs.ss1;

import android.os.Bundle;

import ch.hevs.kart.AbstractKartControlActivity;
import ch.hevs.kart.Kart;

public class MyKartRemote extends AbstractKartControlActivity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_my_kart_remote);
    }

    @Override
    public void steeringPositionChanged(Kart kart, int i, float v) { }

    @Override
    public void steeringPositionReachedChanged(Kart kart, boolean b) { }

    @Override
    public void batteryVoltageChanged(Kart kart, float v) { }

    @Override
    public void sequenceCompleted(Kart kart) { }

    @Override
    public void connectionStatusChanged(Kart kart, boolean b) { }

    @Override
    public void message(Kart kart, String s) { }
}
```

8 Modify **AndroidManifest.xml**

```xml
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    package="ch.hevs.ss1">

    <application
        android:allowBackup="false"
        android:label="@string/app_name"
        android:supportsRtl="true"
        tools:ignore="GoogleAppIndexingWarning">

        <activity android:name=".MyKartRemote">
            <intent-filter>
                <action android:name="android.intent.action.RUN" />
                <category android:name="ch.hevs.kart.RCA" />
            </intent-filter>
        </activity>

    </application>

</manifest>
```

honor 10 Lite

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- Connect Phone to PC's USB port
- Power on the phone
- Use default configurations during setup wizard
- Enable developer mode:
  Go to Settings > System > About Phone and press 7 times on „Build Number"
- Enable USB debugging:
  Go to Settings > System > Developer options and check „USB debugging"
- Install and start your Android application:
  - In Android Studio, press green ▶ button and select honor 10 Lite phone from the list.
  - On the phone, answer yes to allow USB debugging in popup.
  - Now your application should be running on the phone.

Virtual Kart

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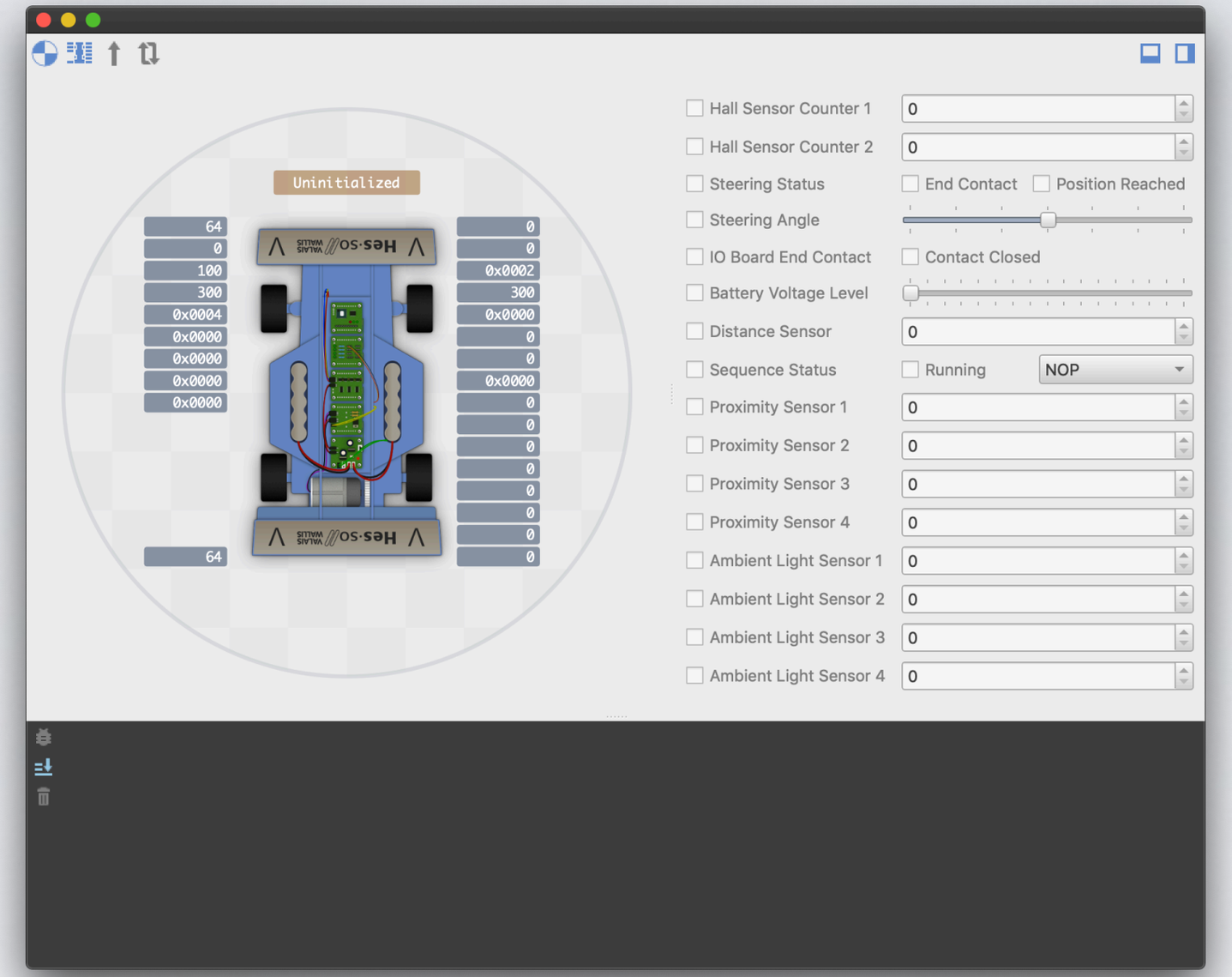

Install & Run Demo

Download **Kart.apk** from:
http://wiki.hevs.ch/fsi/index.php5/Kart_2020

Install it using the **adb** command line tool:

```
c:\Users\your.account> c:\Android\sdk\platform-tools\adb install Downloads\Kart.apk
3979 KB/s (937315 bytes in 0.230s)
        pkg: /data/local/tmp/Kart.apk
Success
```

Tipp #1: Read the docs

- **You find all information needed here:**
  - Your copy of the kart project documentation and tasks document
  - Kart wiki: http://wiki.hevs.ch/fsi/index.php5/Kart_2020
  - Kart project JavaDoc: http://kart-javadoc.hevs.ch
  - Android: https://developer.android.com/index.html

Ask us, we kindly like to help you!

Tipp #2: Pair with your kart

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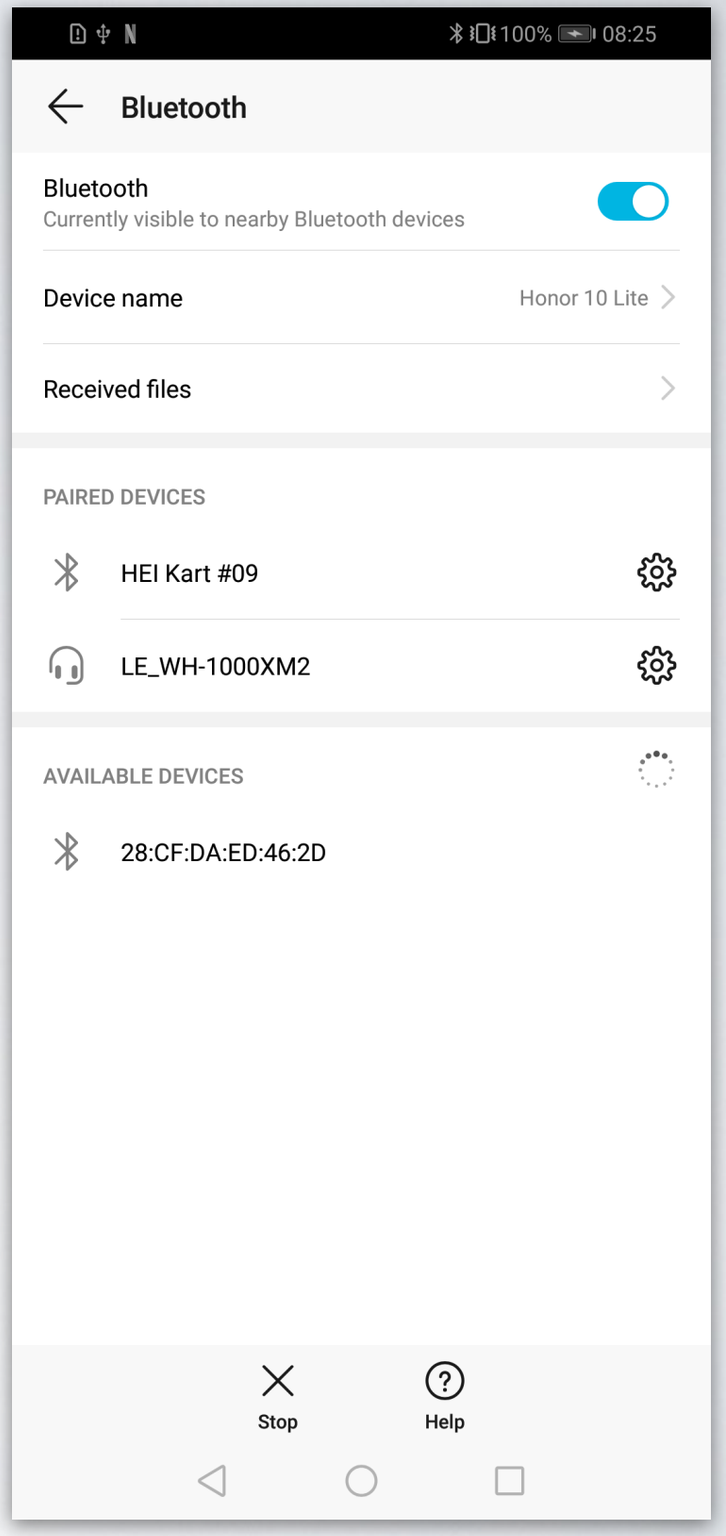
You need to pair with your kart before it will be listed by the Kart app

Open "Settings"

Go to "Device connectivity" > "Bluetooth"

Select your kart in "Available Devices"



Tipp #3: No infinite loops

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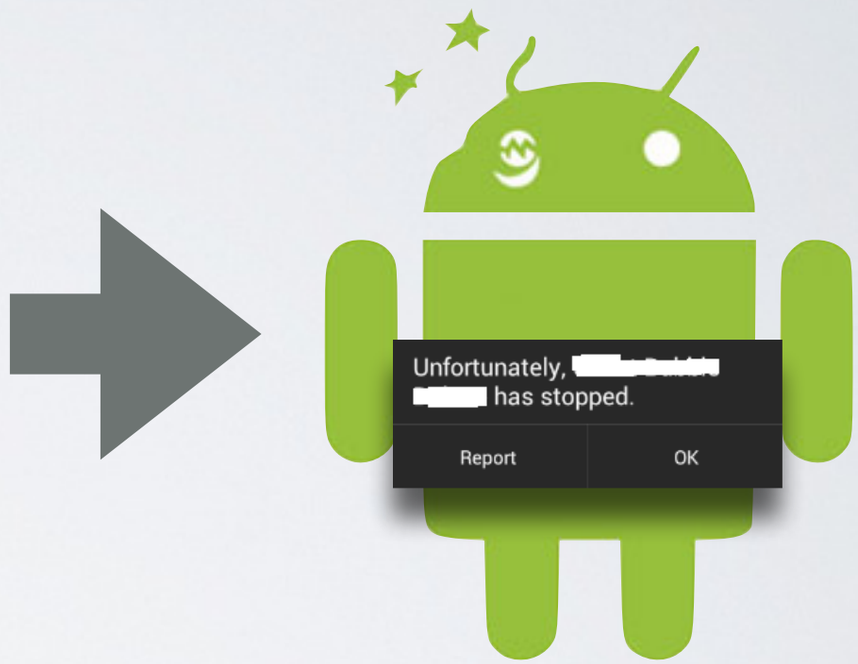
```
// Blink a led
try {
    while (true) {
        kart.setLed(0, true);
        Thread.sleep(500);
        kart.setLed(0, false);
        Thread.sleep(500);
    }
} catch (InterruptedException e) {
    e.printStackTrace();
}
```

If you add infinite loops to the main thread, your application will crash!



Tipp #4: Periodic Timer

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Inside your Activity, add the attribute:

```
private Timer ledBlinker = new Timer() {
    @Override
    public void onTimeout() {
        kart.toggleLed(0);
    }
};
```

You can start the timer using:

```
ledBlinker.schedulePeriodically(500);
```

You can stop the timer with:

```
ledBlinker.stop();
```

Documentation:

http://kart-javadoc.hevs.ch/ch/hevs/kart/utils/Timer.html

Tipp #5: Doing something later


```
Timer doLater = new Timer() {
    @Override
    public void onTimeout() {
        kart.setLed(0, true);
    }
};
doLater.scheduleOnce(5000);
```

This code snippet will turn the LED 0 on after 5 seconds.

Documentation:

http://kart-javadoc.hevs.ch/ch/hevs/kart/utils/Timer.html

Tipp #6: Animations…

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```
Animation animation = Animation.Builder(kart)
        .ledOn(0).ledOff(1).wait(100)
        .ledOff(0).ledOn(1).wait(100)
        .build();
animation.loop();
```

The animation will turn LED 0 on and LED 1 off, then wait for 0.1s. Next it will turn LED 0 off and LED 1 on and then wait again for 0.1s. The animation is looped until the method **cancel()** is called…

Documentation:

http://kart-javadoc.hevs.ch/ch/hevs/kart/utils/Animation.html
http://kart-javadoc.hevs.ch/ch/hevs/kart/utils/Animation.Builder.html

Tipp #7: Enumerations

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You may not have seen Java Enumerations during your first year informatics course…

```java
public enum DayOfWeek {
    MONDAY,
    TUESDAY,
    WEDNESDAY,
    THURSDAY,
    FRIDAY,
    SATURDAY,
    SUNDAY
}
```

DayofWeek.java

```
Worktime
Today is TUESDAY
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
```

Program output

```java
DayOfWeek today = DayOfWeek.TUESDAY;

if (today == DayOfWeek.MONDAY) {
    System.out.println("Today sucks!");
}

switch (today) {
    case SATURDAY:
    case SUNDAY:
        System.out.println("Freetime");

    default:
        System.out.println("Worktime");
}

System.out.println("Today is " + today);

for (DayOfWeek dow: DayOfWeek.values()) {
    System.out.println(dow);
}
```

Main.java

Tipp #7: Enumerations

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```java
public enum KartControlRegister {
    DrivePwmPeriod(0),
    DriveSpeed(1),
    SteeringStepPeriod(2),
    SteeringPosition(3),
    SteeringEndSwitchAddress(4),
    HardwareSettings(5),
    LEDs(6),
    SequenceControlRegister(7),
    SequenceFifoRegister(8),
    UpdateInterval(15);

    private final int address;

    KartControlRegister(final int address) {
        this.address = address;
    }

    public int getAddress() {
        return address;
    }

    static final int COUNT = 16;
}
```

KartControlRegister.java

```
KartControlRegister has 16 registers.
LEDs register has address 6
```

Program output

```java
System.out.println("KartControlRegister has " + KartControlRegister.COUNT + " registers. ");

KartControlRegister register = KartControlRegister.LEDs;
System.out.println("" + register + " register has address " + register.getAddress());
```

Main.java