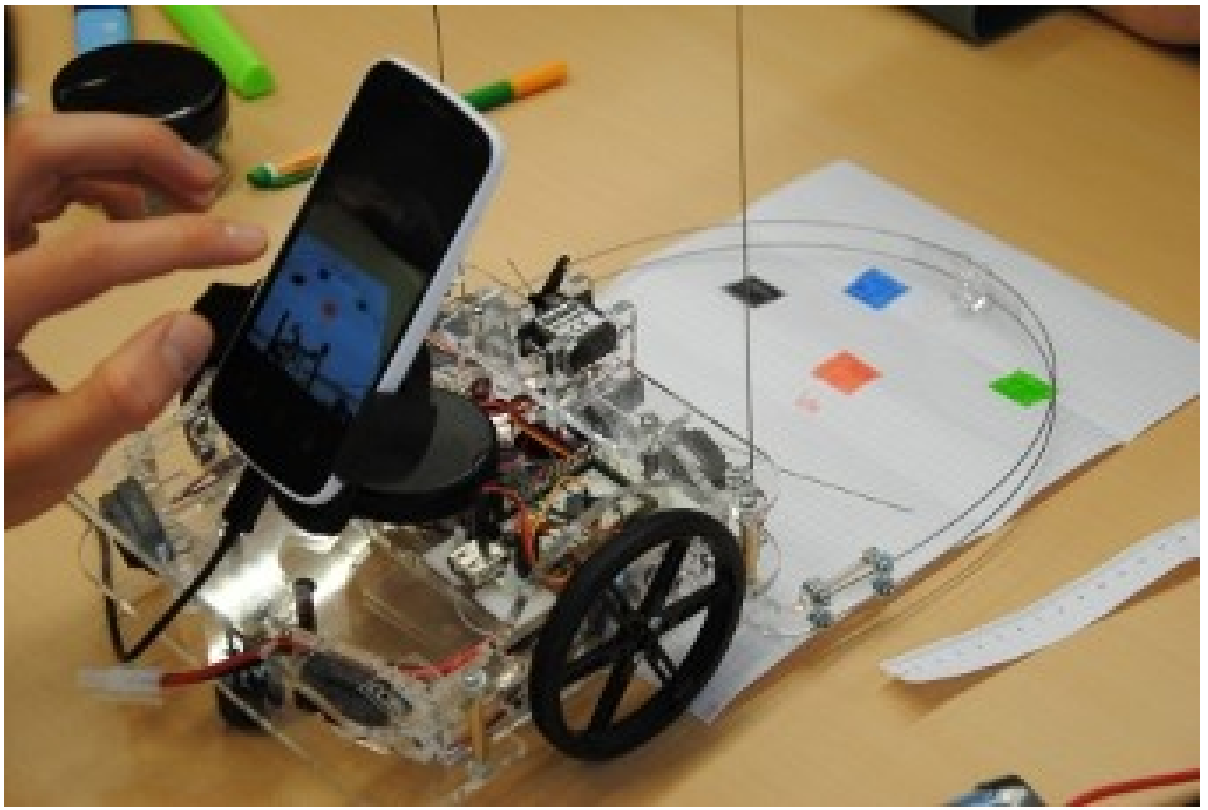
Improved On-Board Communication for Low-Cost Mobile Robots



Autonomous and Intelligent Systems

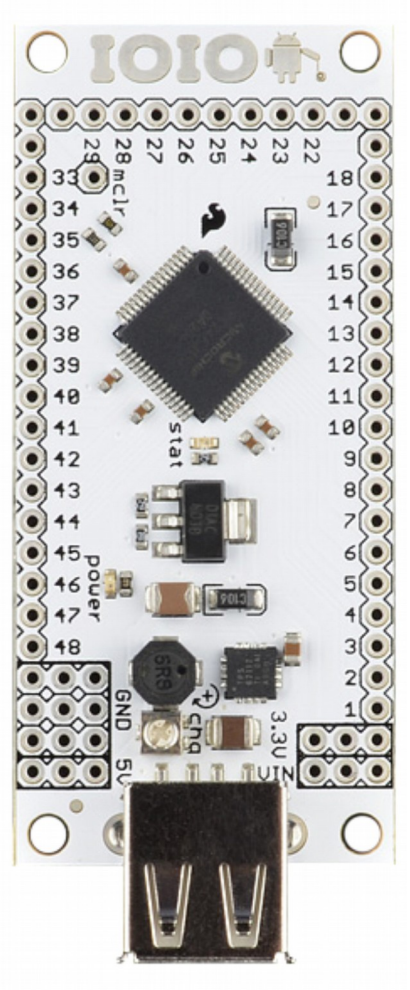
Supervisor: Simon Haller, Justus Piater

Content

- Problems / Goals
- The Robot
- Possible Solutions / Evaluation
- FT311D
- Atmega32
- Android App

My Experience (Summer 2013)

Problems

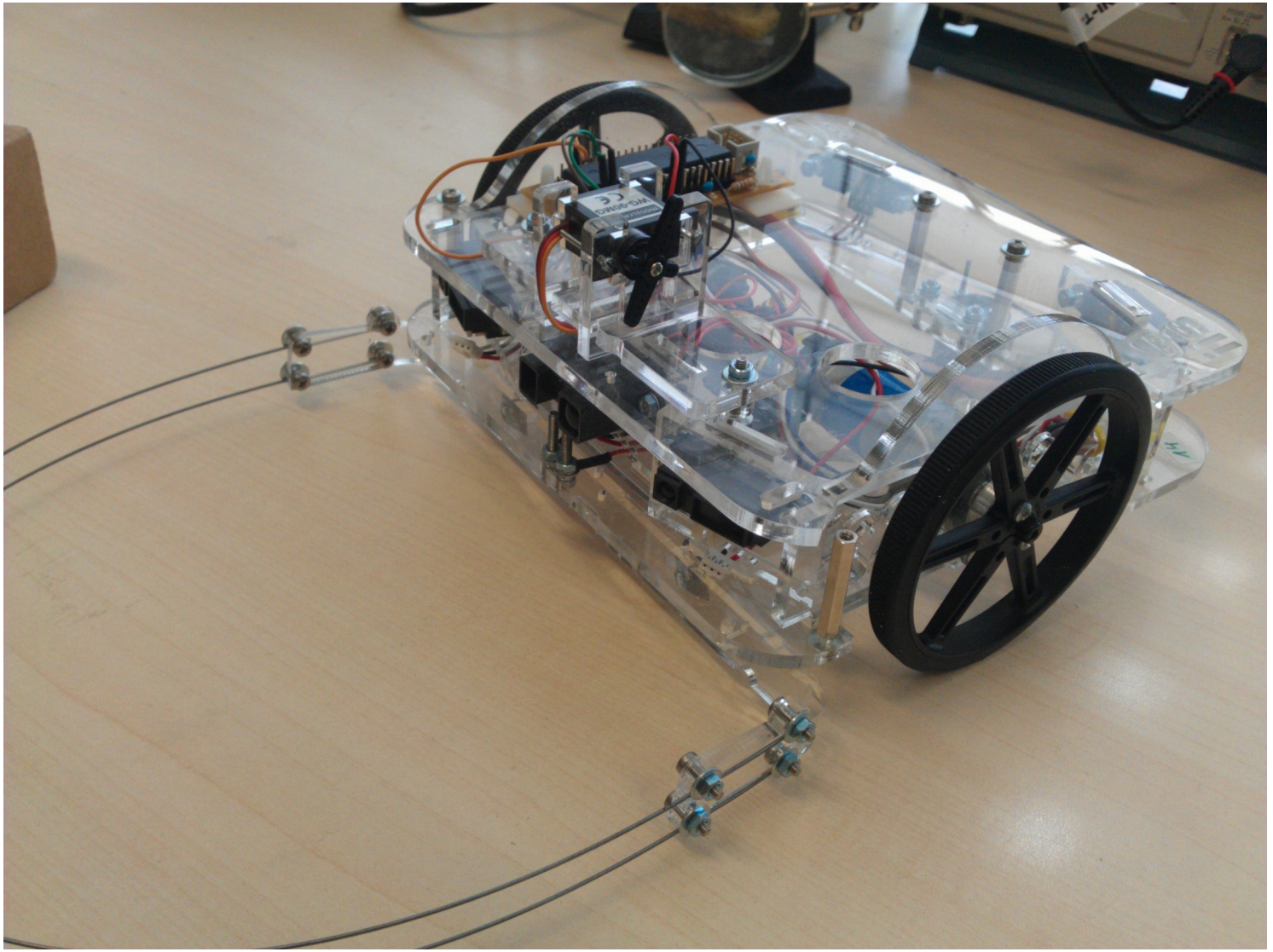


- far too complex for communication
- Multi-threaded connection
- depends on Android Version

Goals

- improved communications (new hardware)
- code examples
- none multi-threaded Android interface
- easy to use
- good documentation
- forward-compatible

The Robot



2 Layers

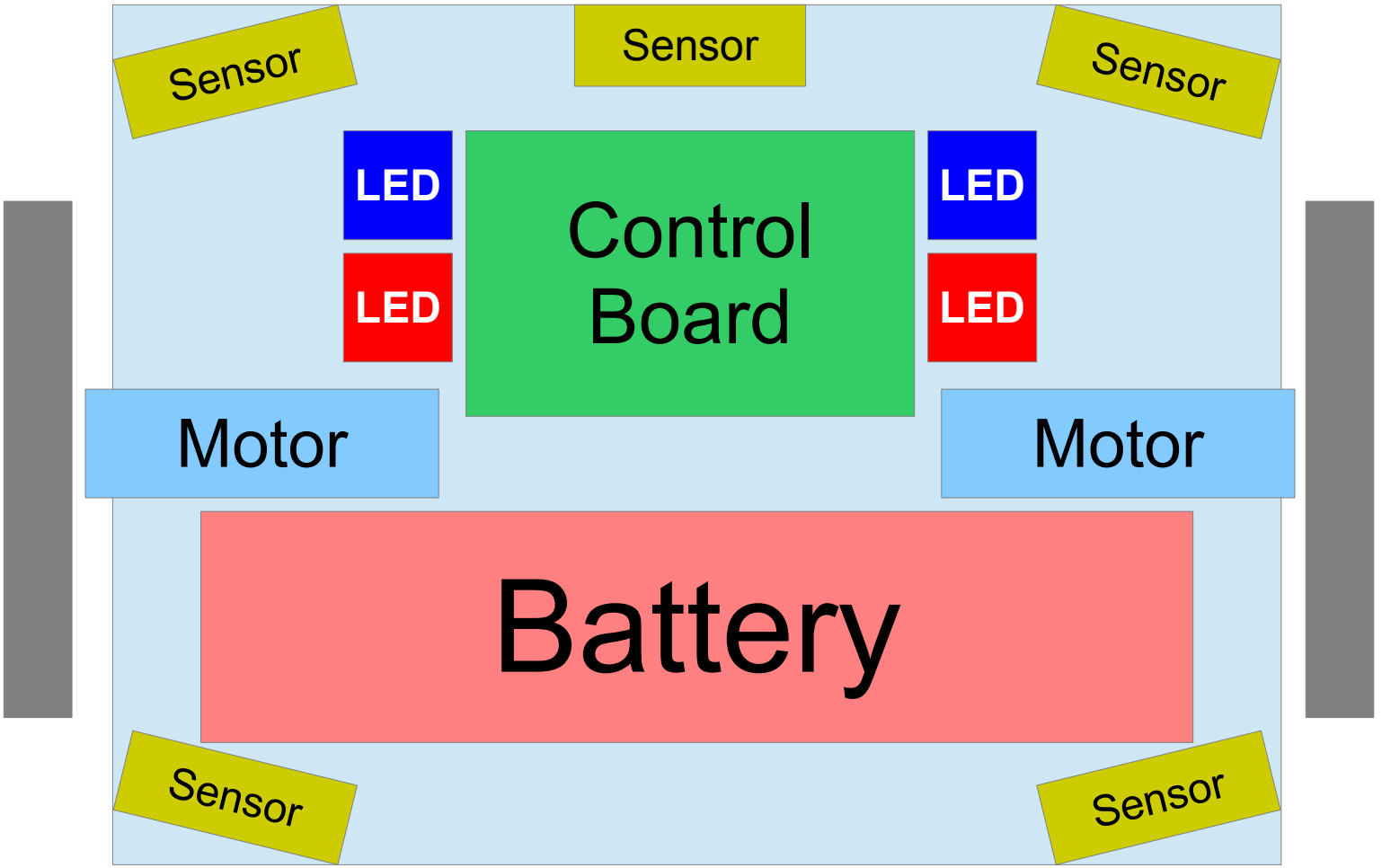
Interior

- DC Motors
- IR Sensors
- Control Board
- Battery

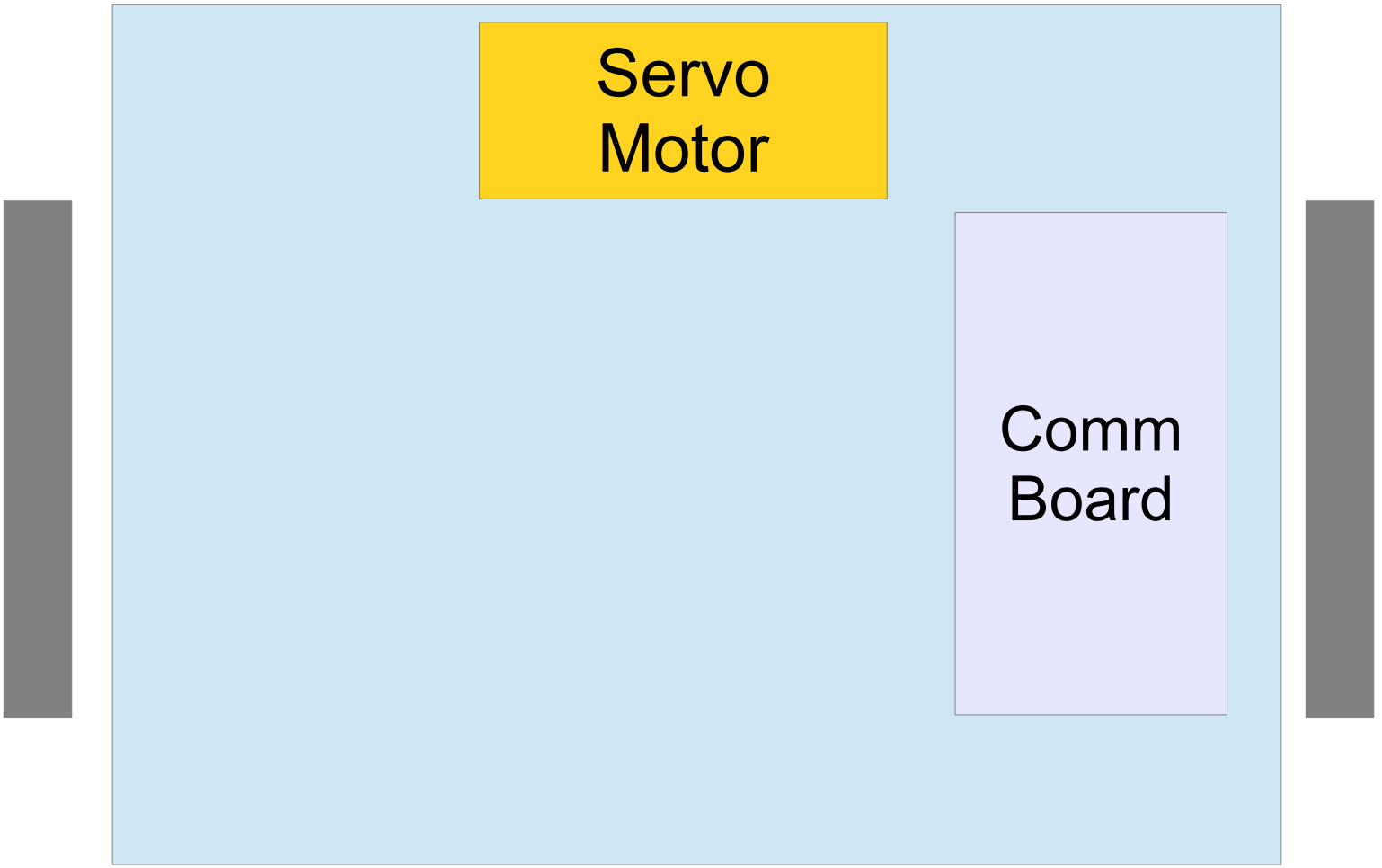
On Top

- **Comm Board**
- Servo Motor (Catching Balls)

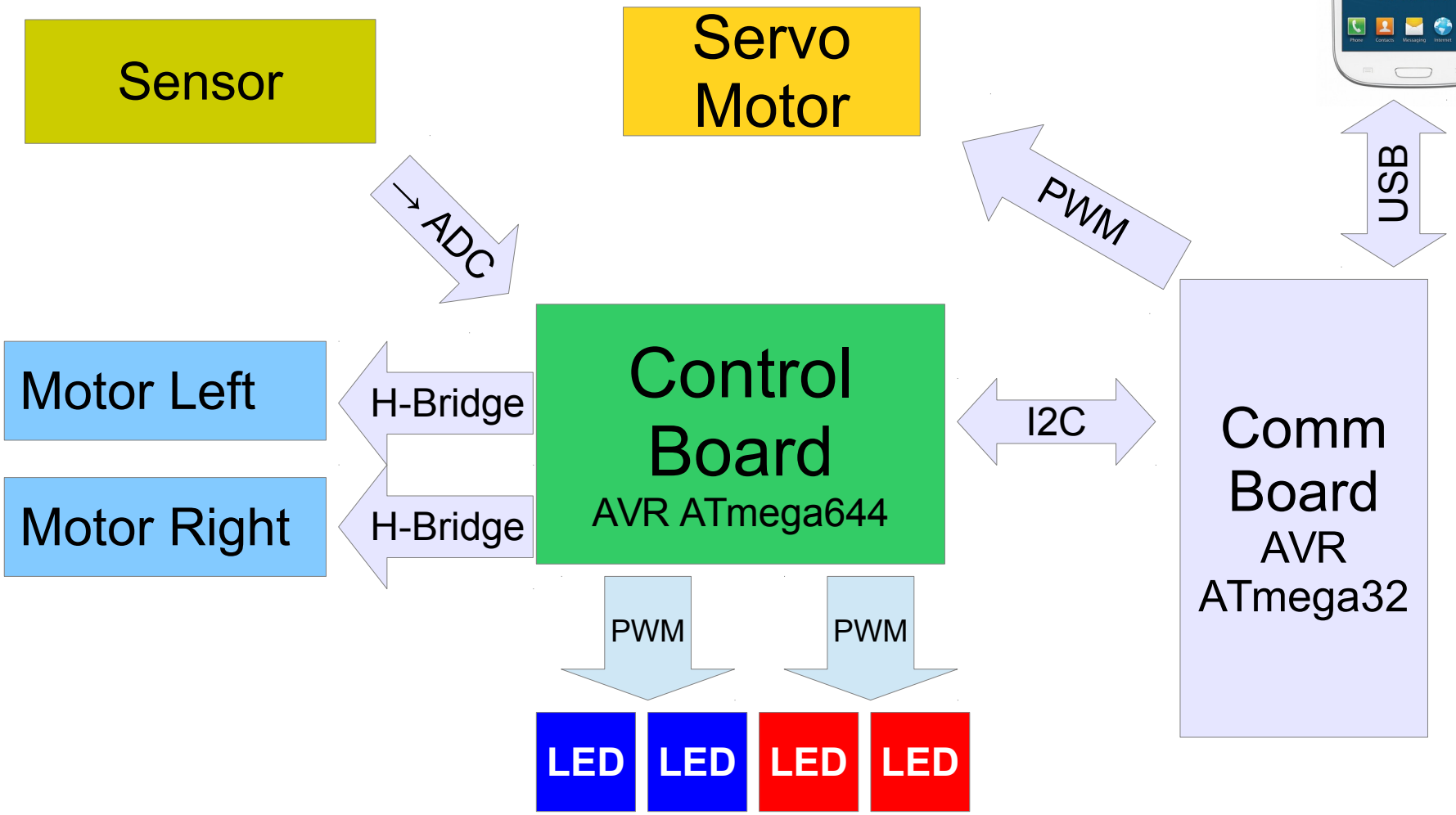
Interior


Sensor
Sensor
Sensor
LED
LED
Control Board
LED
LED
Motor
Motor
Battery
Sensor
Sensor

On Top



Component Interaction



Evaluation

- **Cost** cheap components since multiple robots have to be equipped
- **Simplicity** easy to build, maintain and use
- **Availability** required components must be available
- **Modularity** keep or enhance present modularity
- **Future Oriented** keep forward compatibility to ensure robustness

Candidates

- FT311D
- Arduino Uno
- Raspberry Pi (Model B)
- Beagle Bone Black
- ATmega 32 AVR

Evaluation Result

Candidate	Cost	Simplicity	Availability	Modularity	Future Oriented	**Total**
FT311D	5	5	5	4	3	**22**
ATmega 32	4	3	5	5	4	**21**
Arduino Uno	3	3	4	4	3	**17**
Raspberry Pi	2	2	4	3	4	**15**
Beagle Bone	1	1	2	3	4	**11**

1 – 5 points per category

higher is better

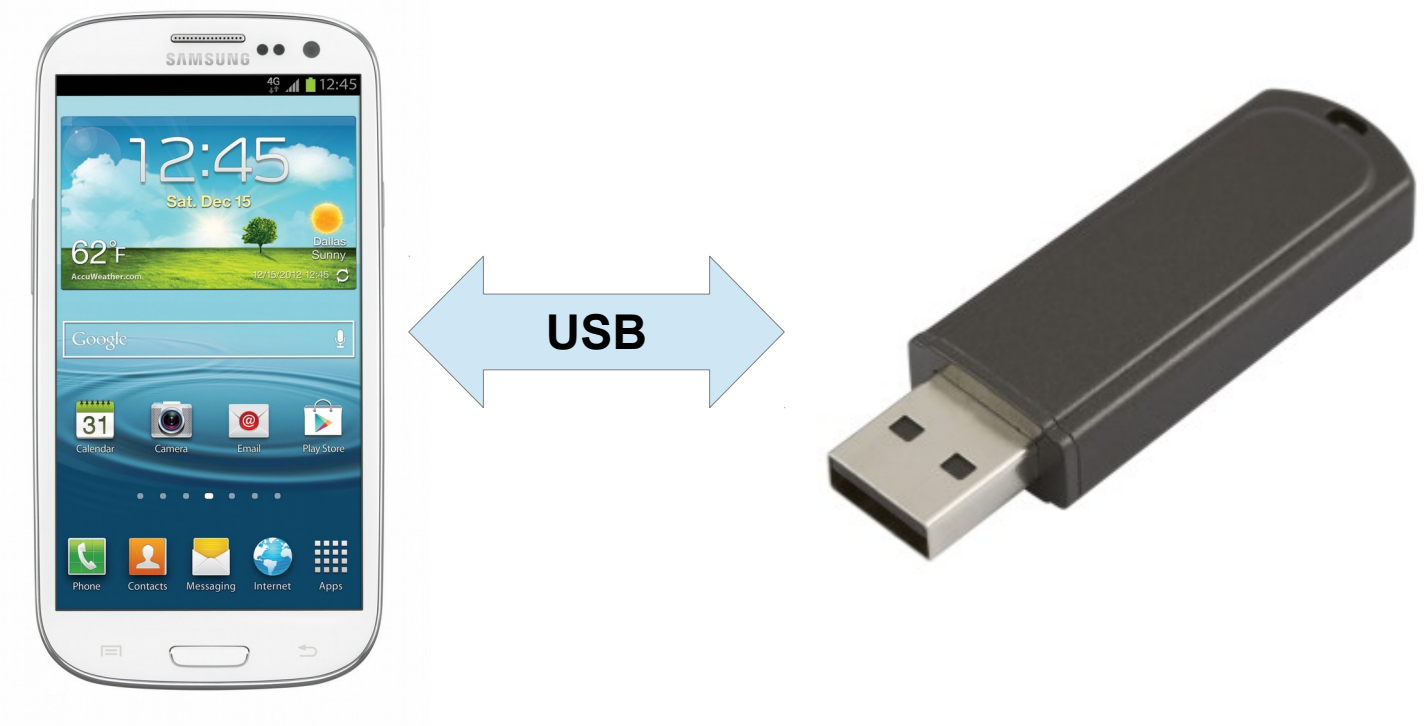
USB Mode: Host + Accessory

Host **Accessory**

- requires driver
- Host has to recognize Accessory

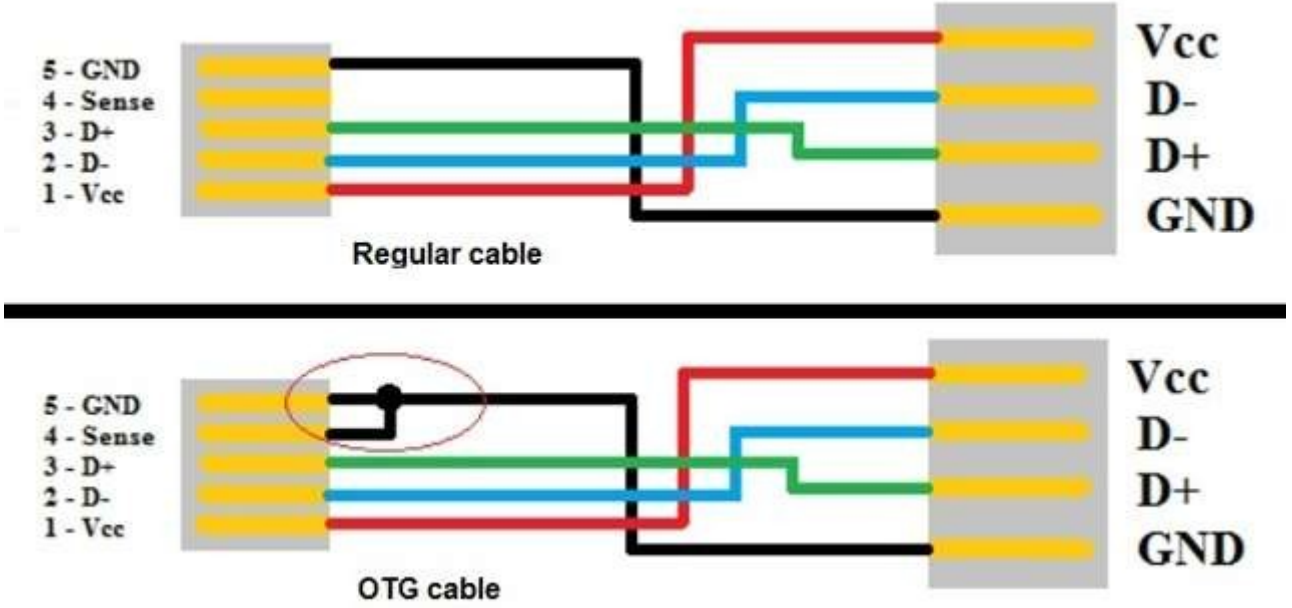
USB Mode: On-The-Go (OTG)

Host **Accessory**

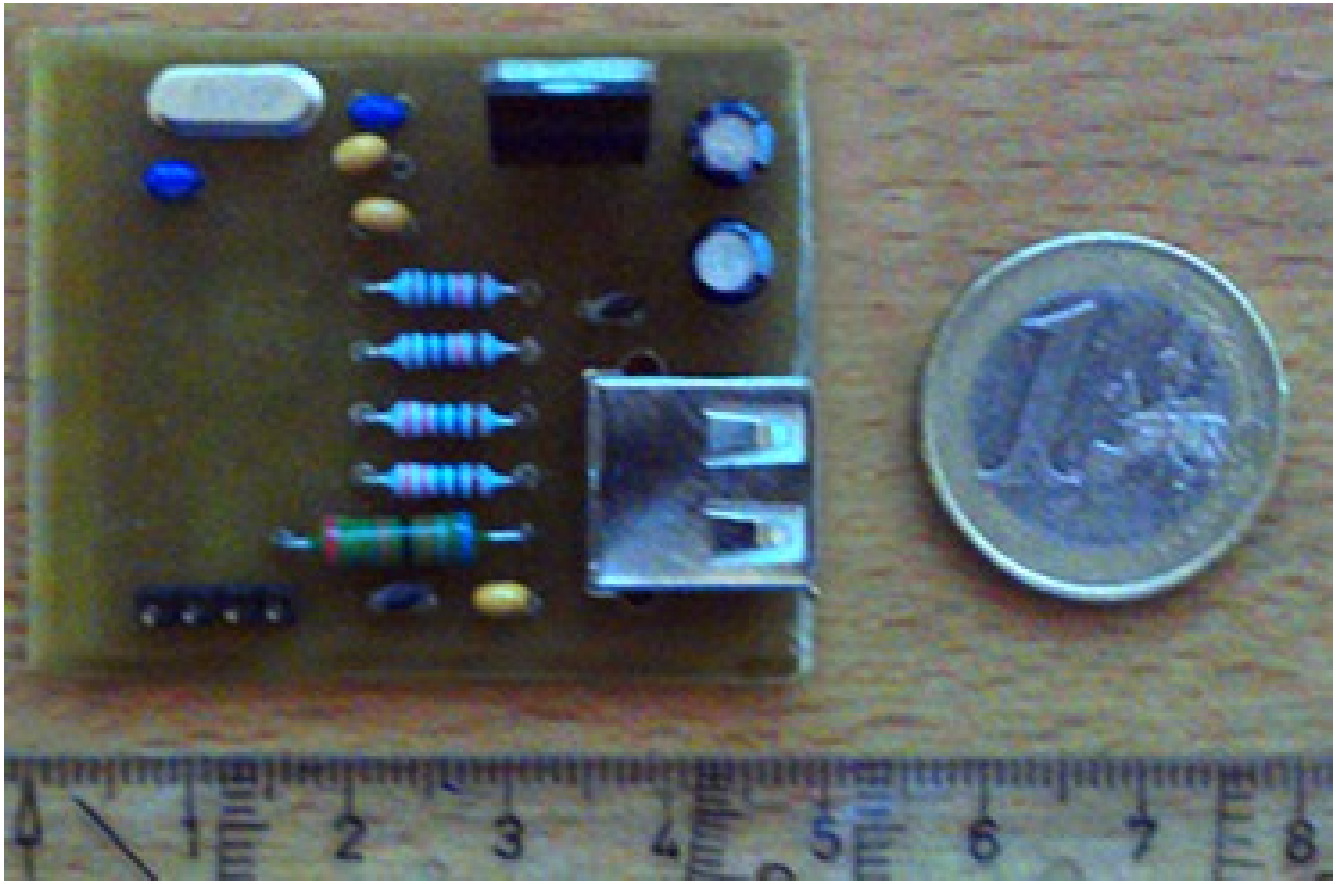


- Requires OTG Cable
- Not all Android phones support OTG

USB OTG (on the go)



FT311D Prototype

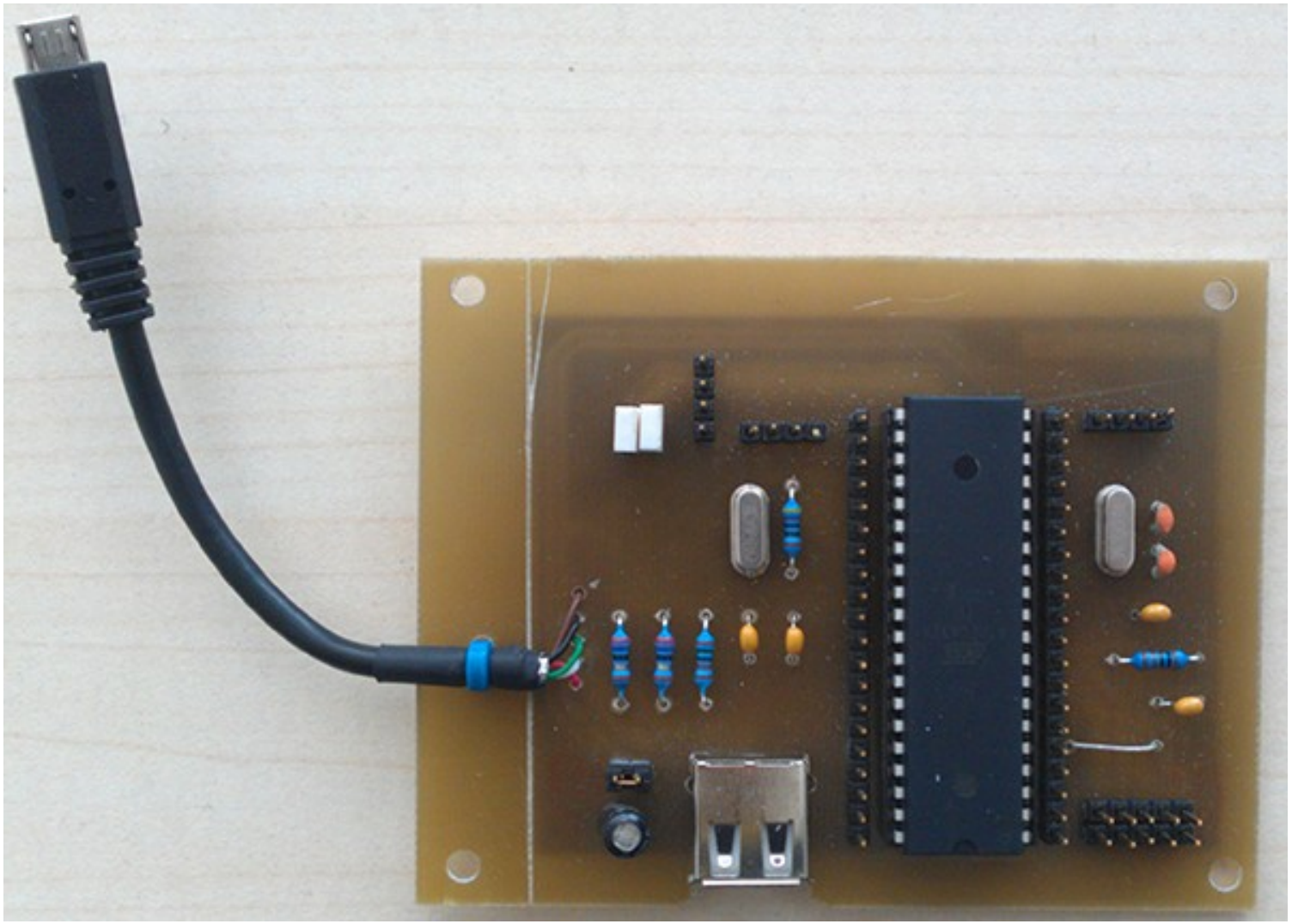


FT311D Prototype

- no programming required
- simple converter
- provides different interfaces (UART, SPI, I2C, ...)

- **Depends on Android Version**

ATmega 32 Prototype



ATmega 32 Prototype

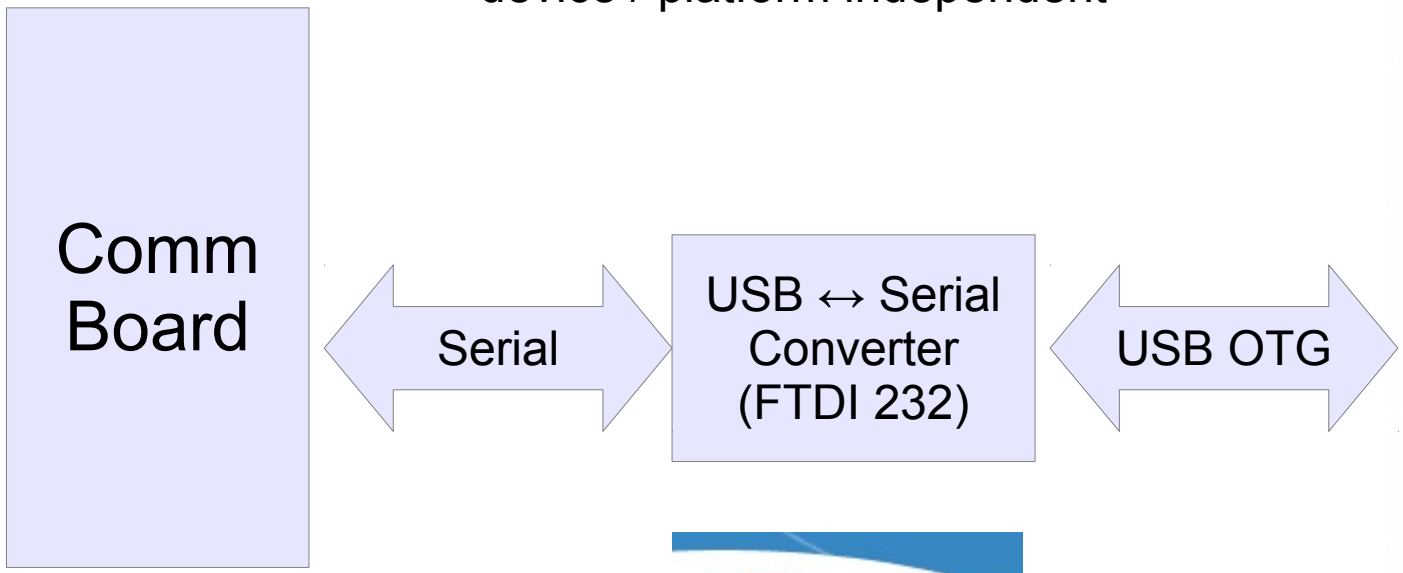
- programmable
- has useful hardware peripherals
- more than just a converter
- good documentation

- not capable of USB handling
  requires simple USB to serial converter

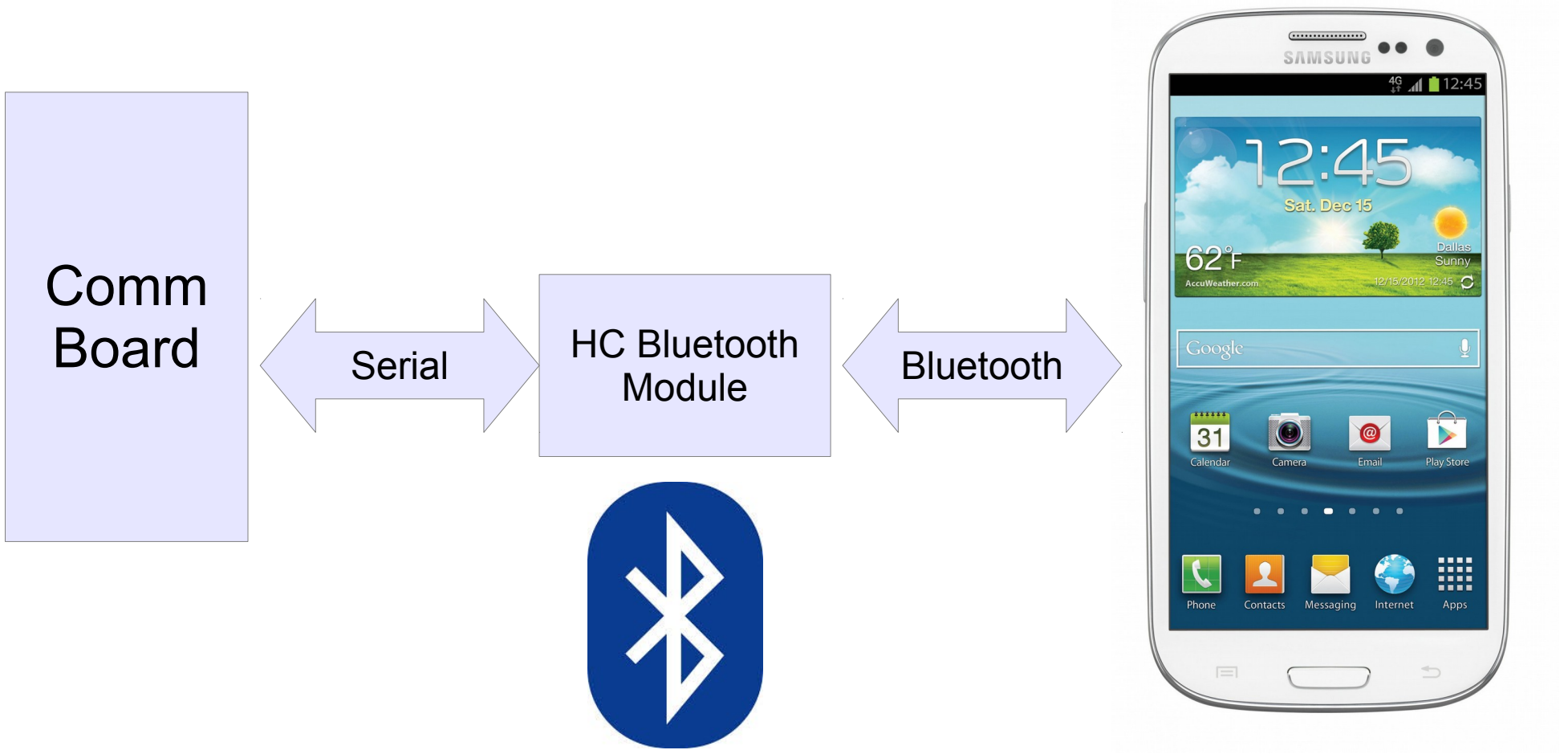
Communication (wired)

Benefits of Serial Connection:

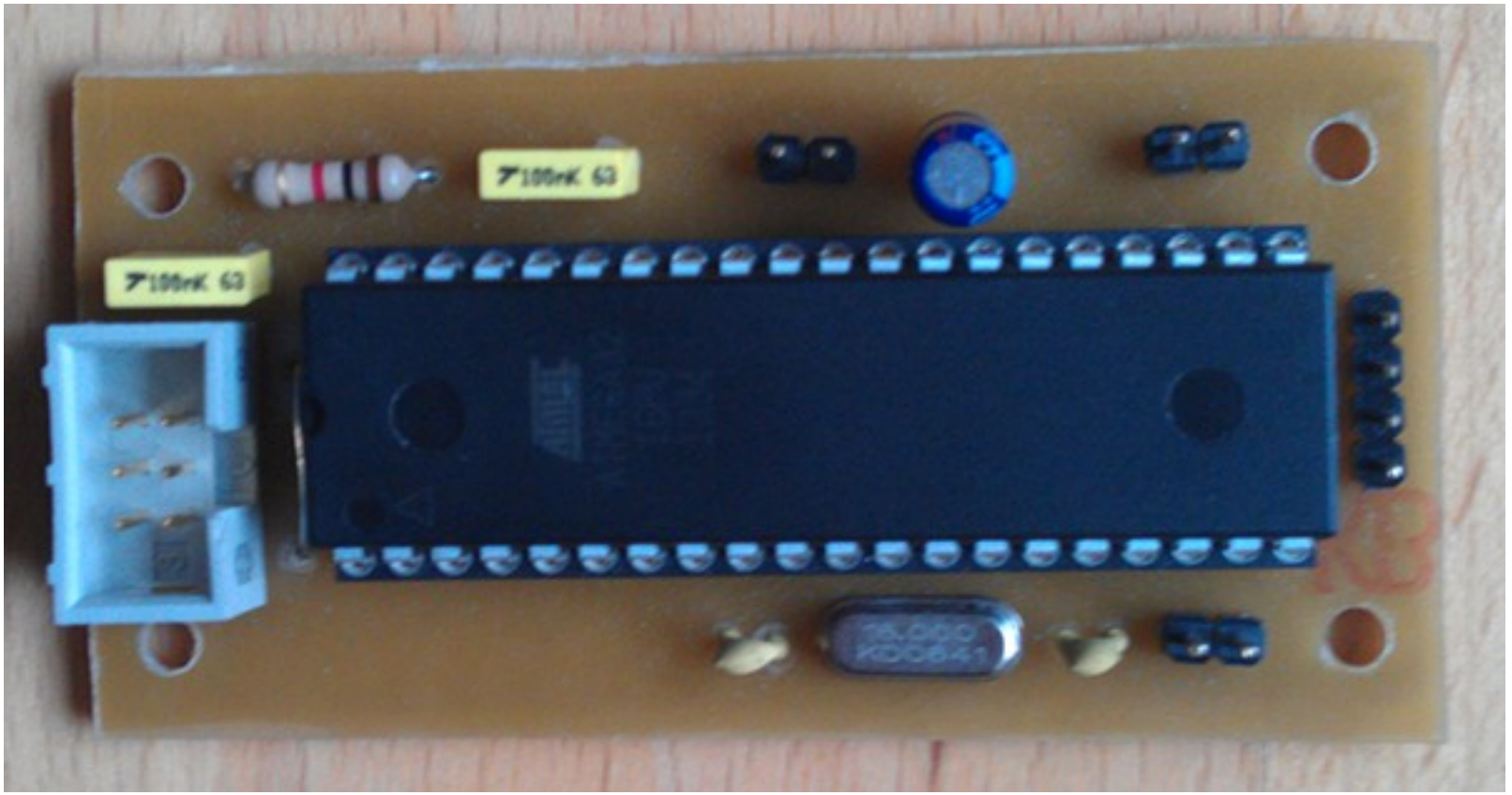
- very easy compared to USB
- device / platform independent



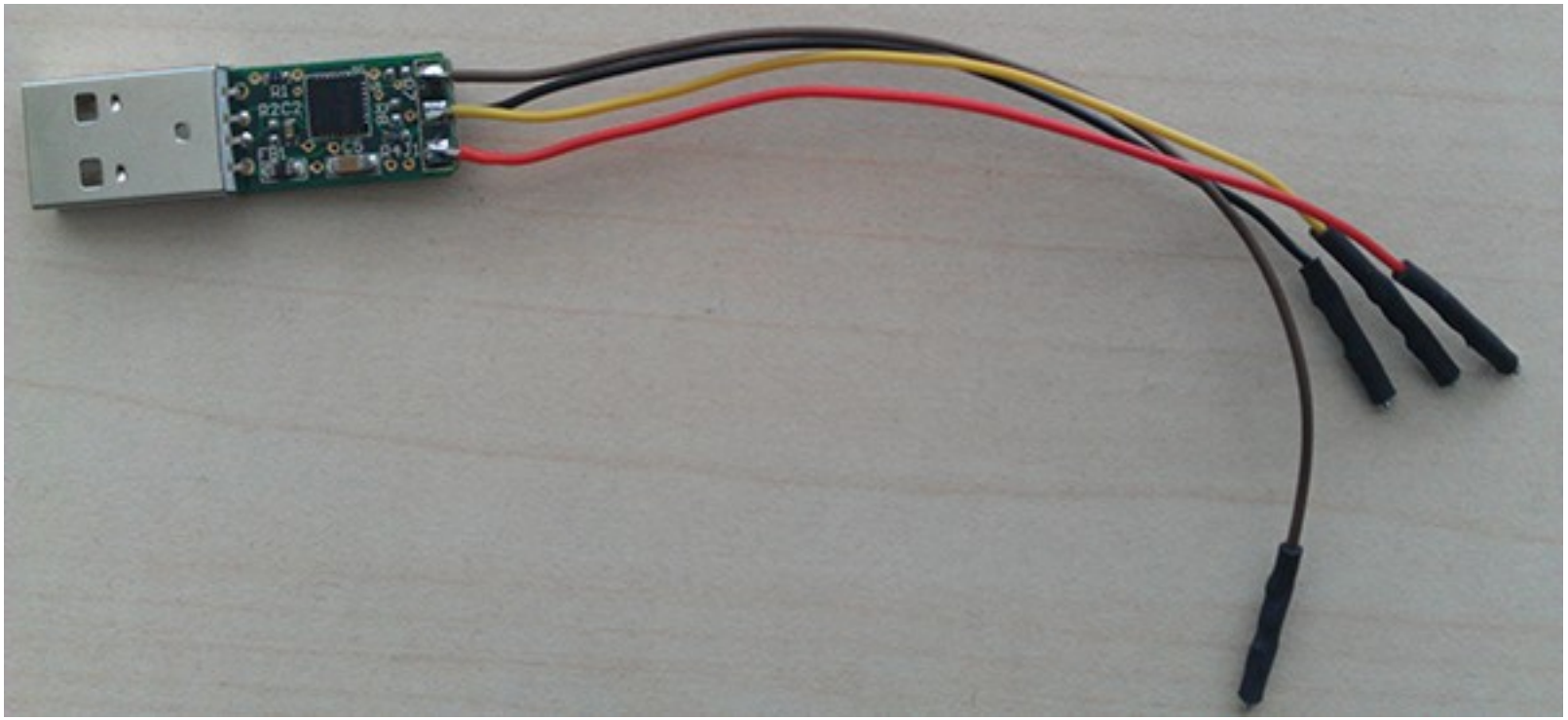
Communication (wireless)



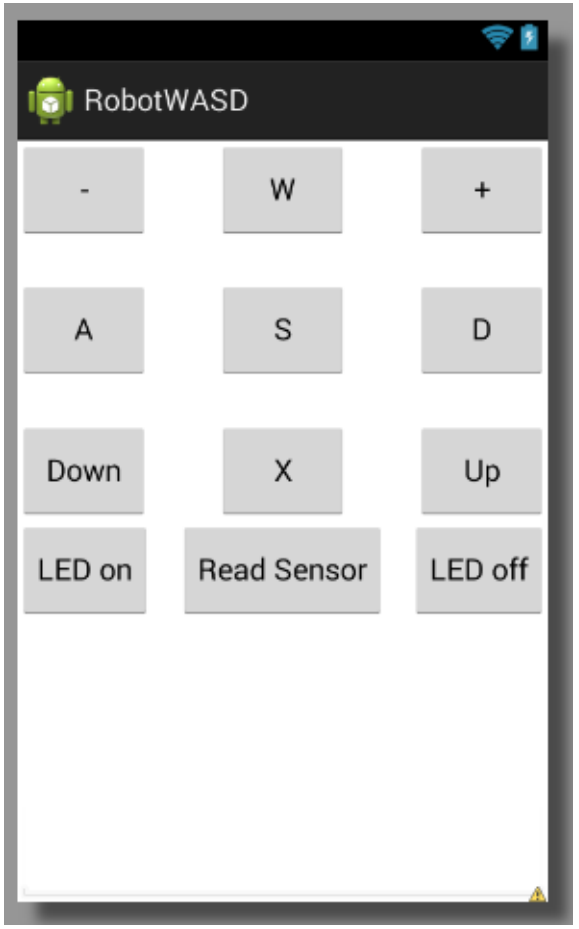
Final Board



USB to serial Converter



Android App



- Move robot
- Toggle LEDs
- Read in sensor data
- Move cage

Future

- Combine CommBoard and ControlBoard
- Replace Android phone with embedded system
- Improve the robot's casing

Questions?

source code:

http://git.io/wVlDzg