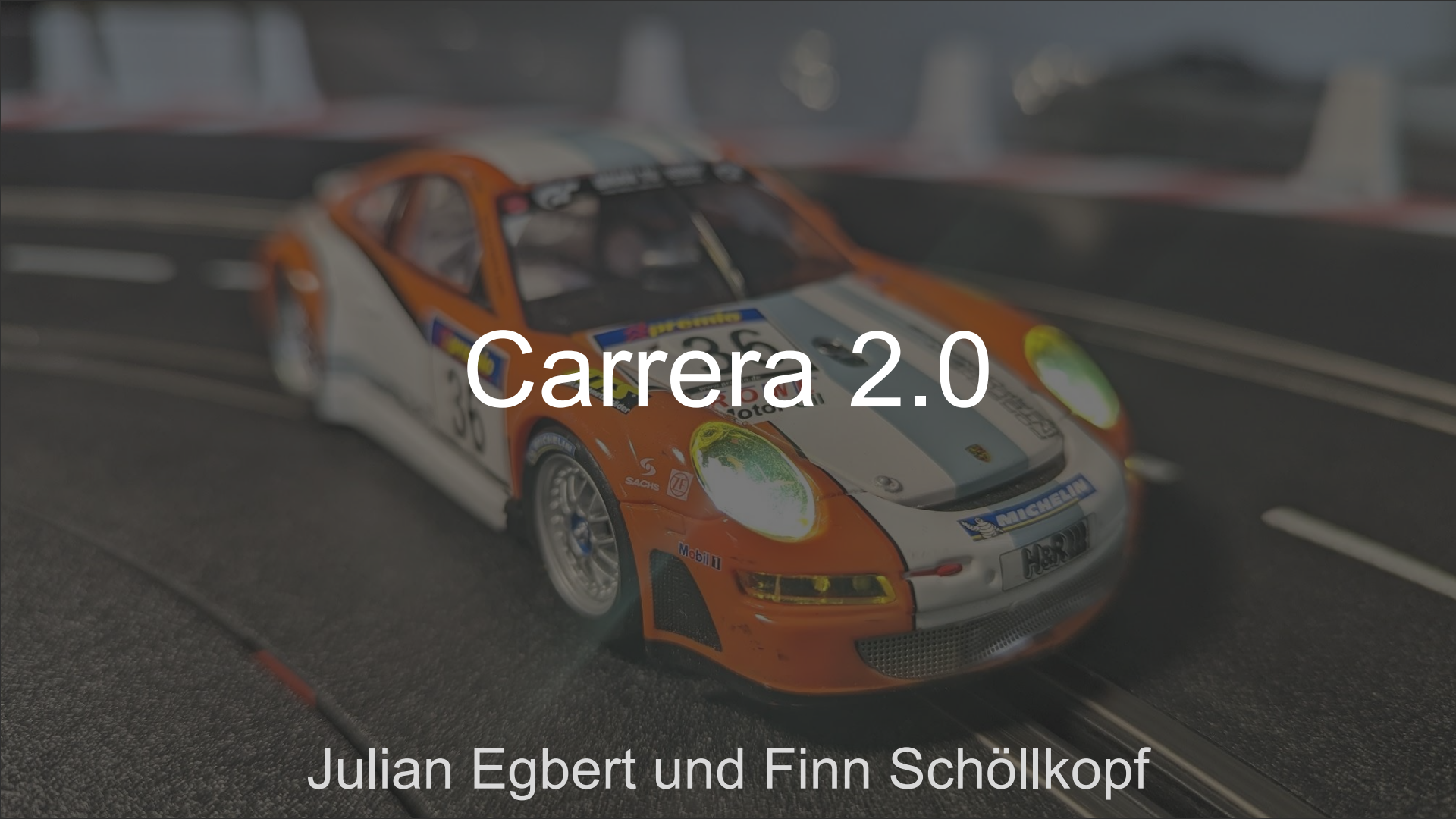



# Carrera 2.0

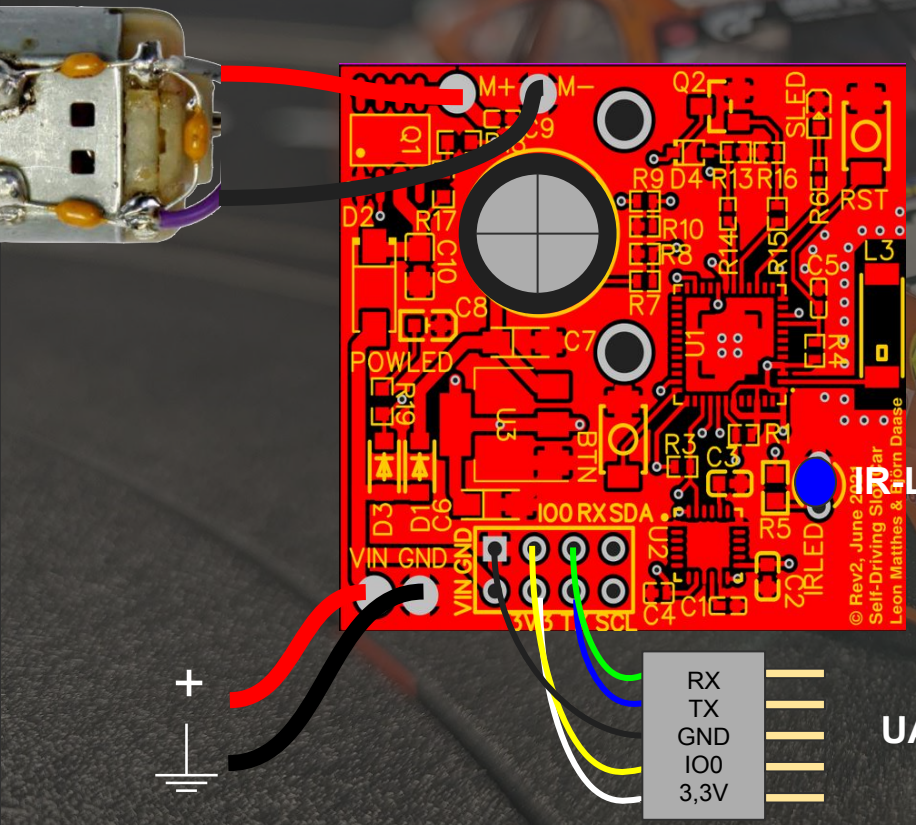
Julian Egbert und Finn Schöllkopf

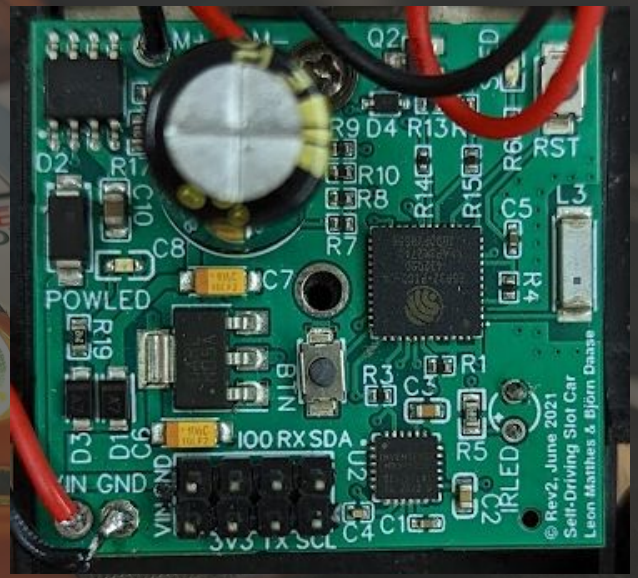
# Projektidee

Alternative Steuerung von Carrera-Autos per Handy/Computer


# Was bisher geschah

# Was bisher geschah - Hardware



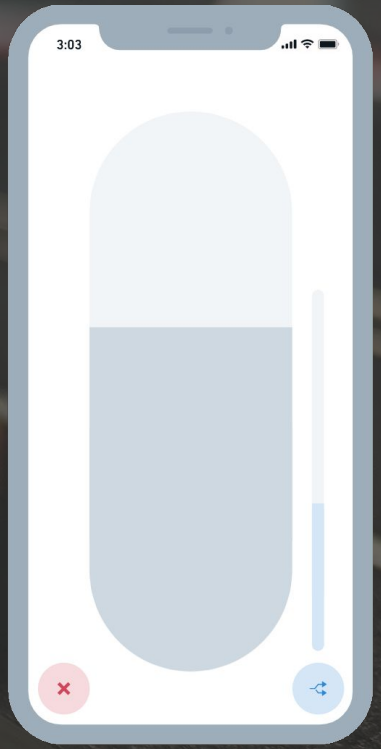



# Was bisher geschah - Software

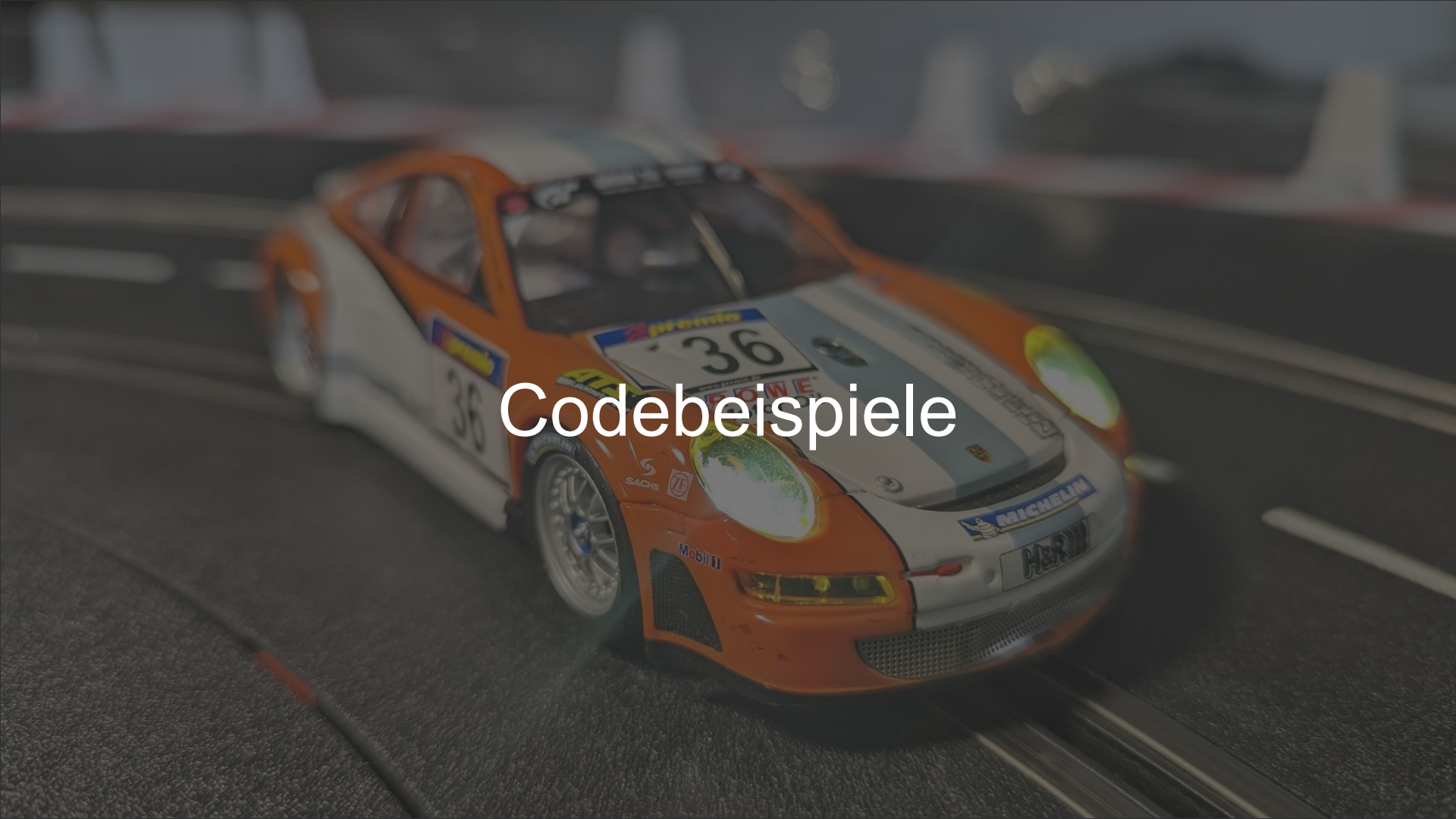
- ESP öffnet WiFi Access Point
- Steuerungs-Webseite im Browser erreichbar
  - Geschwindigkeitsregler zur Bedienung
  - Aktivierung der IR-Led
  - Not-Aus

- OTA Updates


Aktuelles UI




Mock-Entwurf des UI



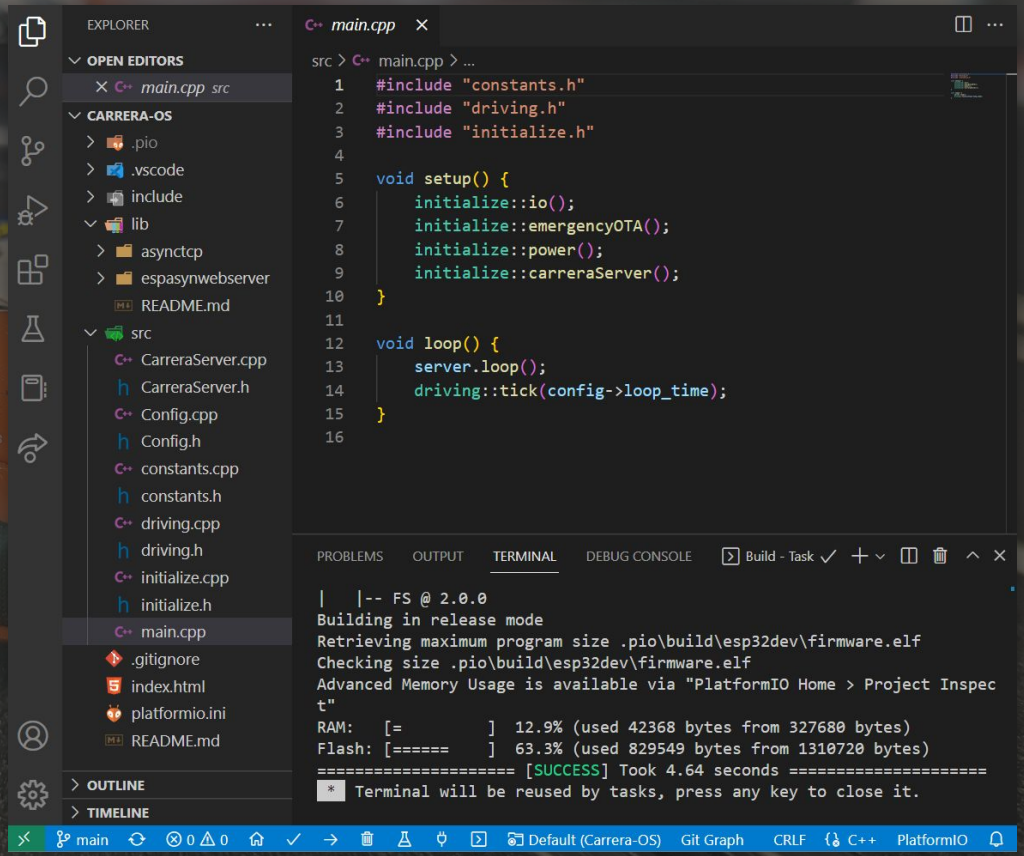

# Codebeispiele

# Web-Server

```
1  void CarreraServer::setup() {
2      WiFi.softAP(ssid, password);
3
4      initWebSocket();
5
6      m_server.on("/", HTTP_GET, [](AsyncWebServerRequest *request) {
7          request->send_P(200, "text/html", index_html);
8      });
9      m_server.on("/OTA", HTTP_GET, [&](AsyncWebServerRequest *request) {
10         request->send(200, "text/plain", "Ready for OTA!");
11         ota_mode = true;
12     });
13     m_server.on("/uptime", HTTP_GET, [](AsyncWebServerRequest *request) {
14         request->send(200, "text/plain", String(millis()));
15     });
16
17     m_server.begin();
18 }
```

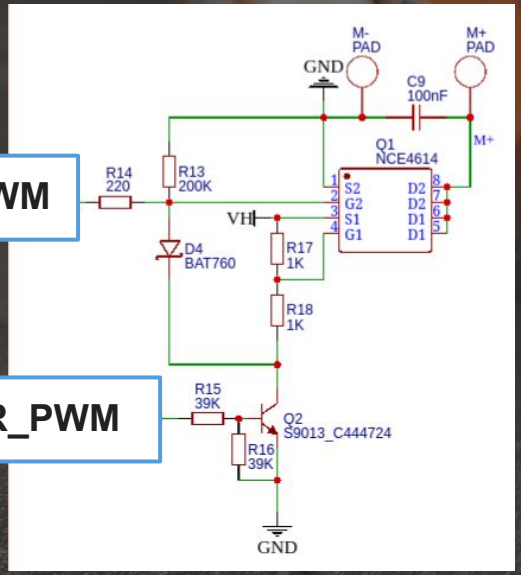

# Platform IO & VS-Code

- Kompilieren und flashen
- Übersichtliche IDE
- Easy to use
- Git-Integration



# Motorsteuerung

- accelerate/decelerate über PWM Signal




**BRK_PWM**

**MOTOR_PWM**

```
1  float target_speed = 0;
2  float real_speed = 0;
3
4  void decelerate(uint32_t duty) {
5      ledcWrite(MOTOR_PWM_CHANNEL, 0);
6      delay(1);
7      ledcWrite(MOTOR_BRK_PWM_CHANNEL, duty);
8  }
9
10 void accelerate(uint32_t duty) {
11     ledcWrite(MOTOR_BRK_PWM_CHANNEL, 0);
12     delay(1);
13     ledcWrite(MOTOR_PWM_CHANNEL, duty);
14 }
15
16 void driving::tick(float milliseconds) {
17     if (real_speed < target_speed) {
18         accelerate(255);
19         real_speed += config->acceleration * (milliseconds / 1000);
20         if (real_speed >= target_speed) {
21             real_speed = target_speed;
22         }
23     } else if (real_speed > target_speed) {
24         decelerate(255);
25         real_speed -= config->deceleration * (milliseconds / 1000);
26         if (real_speed <= target_speed) {
27             real_speed = target_speed;
28         }
29     } else {  // target_speed and real_speed are equal
30         accelerate(target_speed);
31     }
32 }
```

looptime


# Erste Ergebnisse

# Latenz


2-12 ms

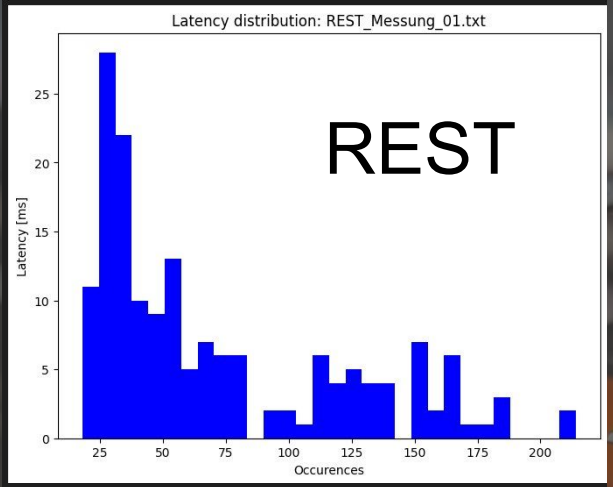
75 ms[1]

Carrera-Logo: https://play-lh.googleusercontent.com/PxqnJWJxvPyMGHbjGPCoNRg-1zHt9BVJsUrZzGliGcVpujo4OeLx6pneJKEXJqdU6A

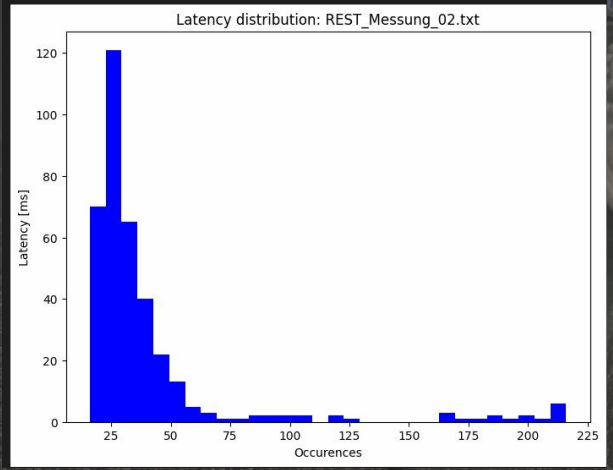
[1]Quelle: http://slotbaer.de/carrera-digital-124-132/9-cu-daten-protokoll.html

# Latenz

Min: 18 ms, Max: 214 ms, AVG: 72.02994011976048 ms.

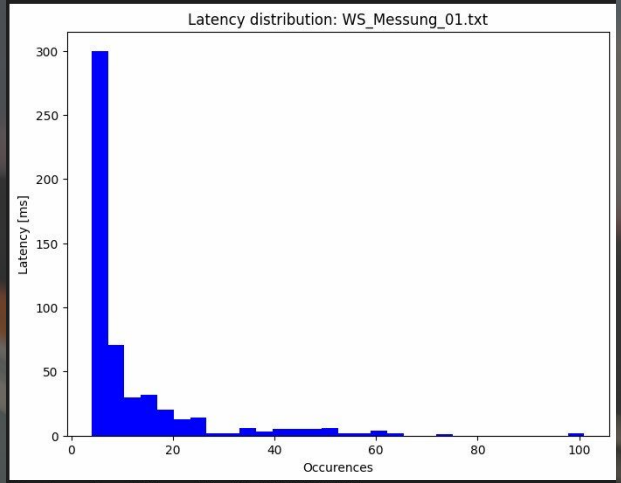



Min: 16 ms, Max: 216 ms, AVG: 40.482384823848236 ms.

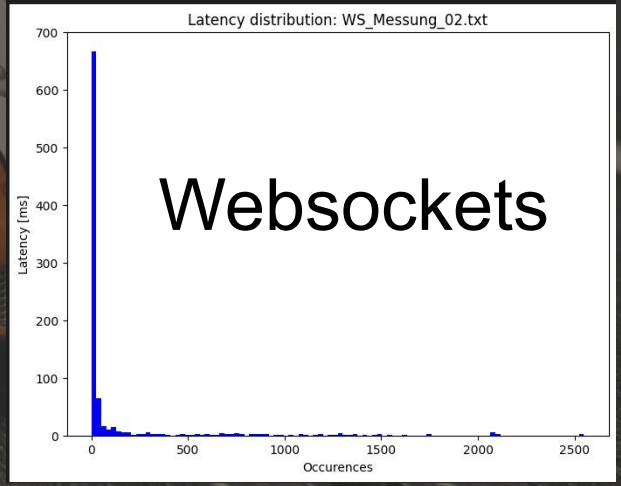



vs.

Min: 4 ms, Max: 101 ms, AVG: 12.15180265654649 ms.

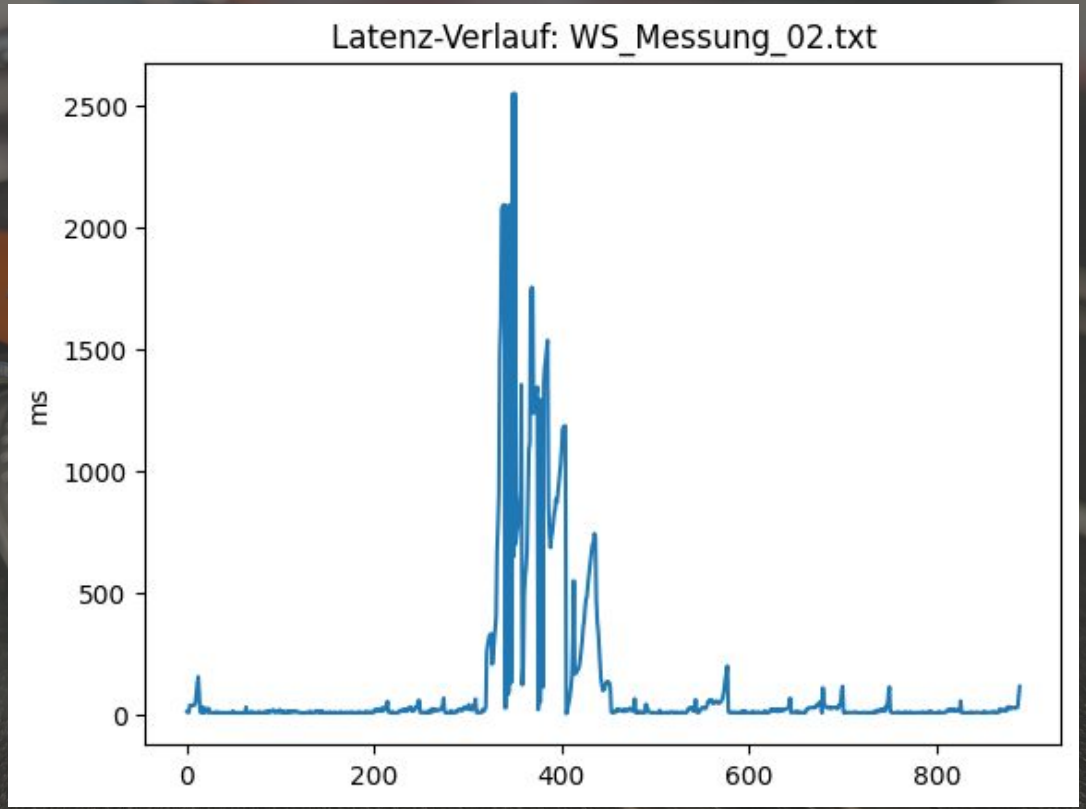



Min: 1 ms, Max: 2549 ms, AVG: 120.80561797752809 ms.



# Woher kommen die “Ausreißer”?

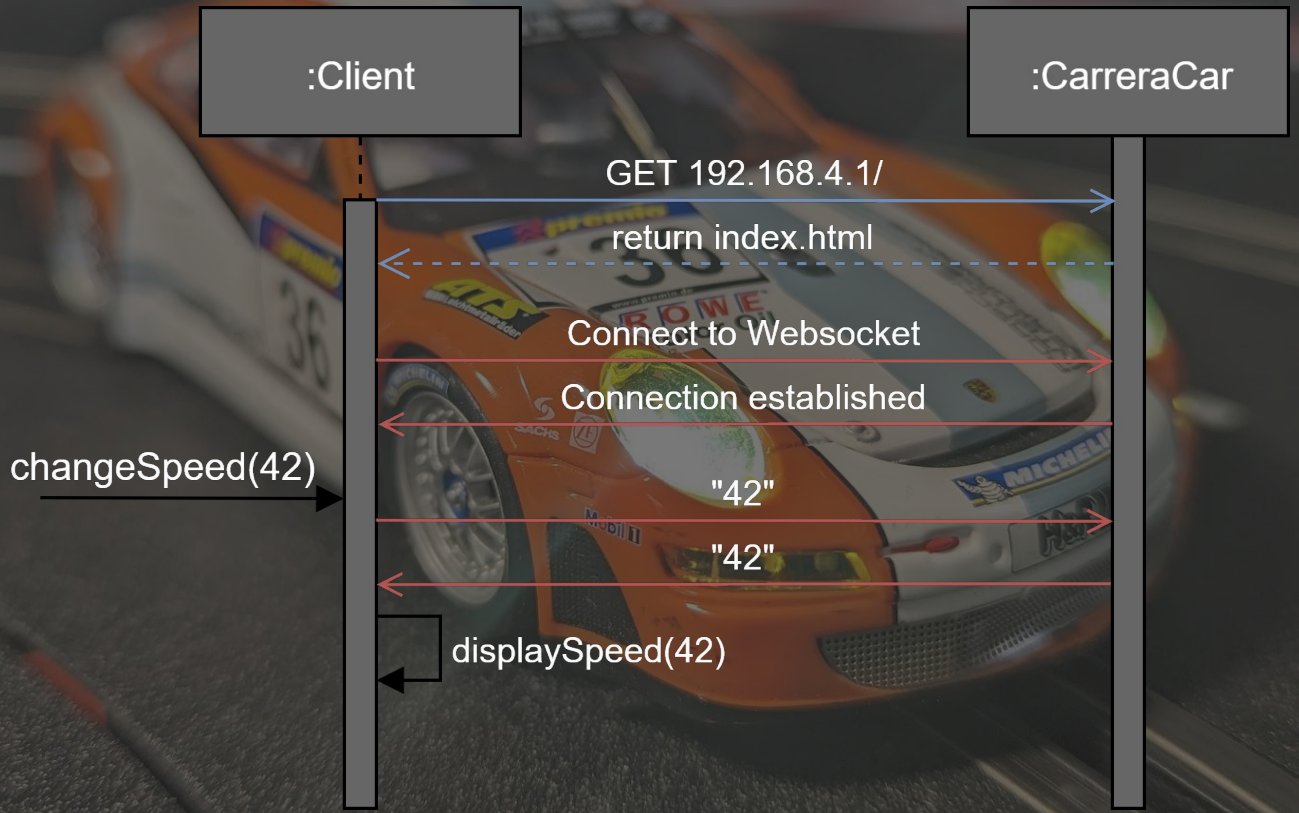
- “Stau” beim **Acknowledgment** der Nachrichten
- Problematisch bei vielen schnellen Änderungen
- Nur im Frontend sichtbar
  - Fahrzeug reagiert weiterhin schnell!



# Hotspot, AP und BLE

| | (externer) WiFi Hotspot | WiFi AccessPoint | Bluetooth (Low Energy) |
|---|---|---|---|
| Vorteile | • Fahrzeug mit Internet verbunden<br>• Fahrzeuge können untereinander kommunizieren | • Kein externer Hotspot notwendig<br>• Keine anderen Nachrichten im WiFi | • Geringerer Stromverbrauch (für BLE) |
| Nachteile | • Mehr irrelevante Pakete anderer Nutzer | • Kein Internet während Nutzung | • Nicht in vielen Browsern unterstützt |

# Kommunikationsprotokoll

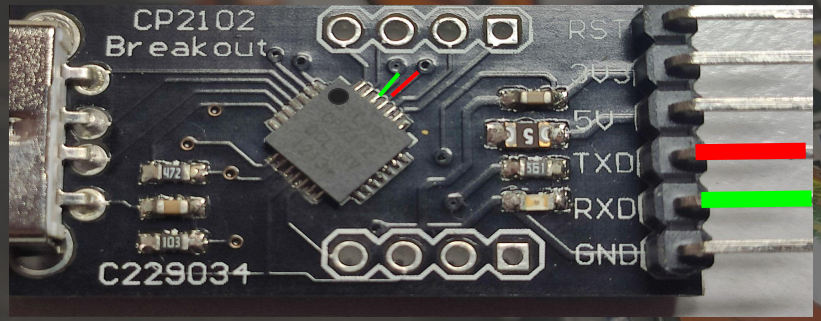


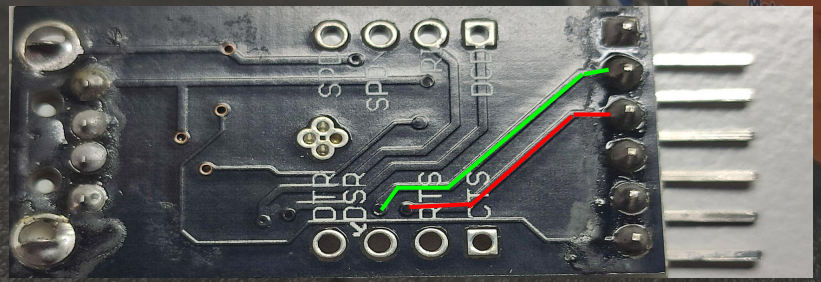

# Ungeplante Probleme

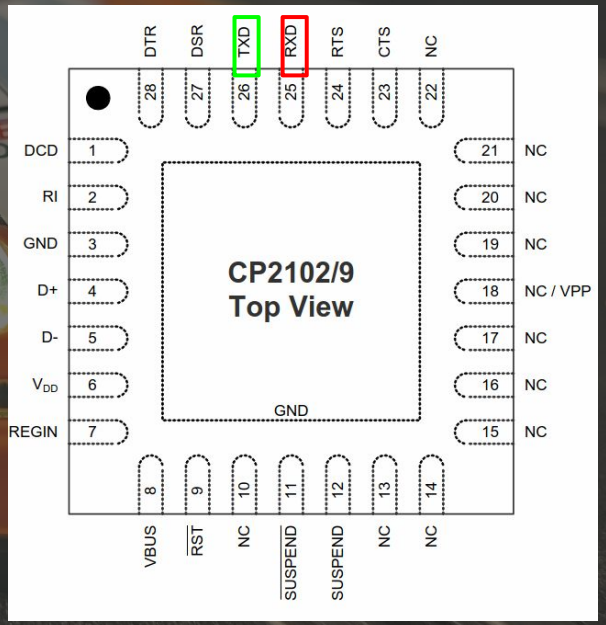
# UART-Bridge

## ESP32 programming

Initial programming of the ESP32 must be done via UART with an external USB to UART bridge. For this connect the RX and TX pins to the UART bridge. Remember to reverse it, TX of the UART bridge must be RX on the ESP and vice versa. Also remember to use a 3.3V UART bridge, NOT a 5V one!



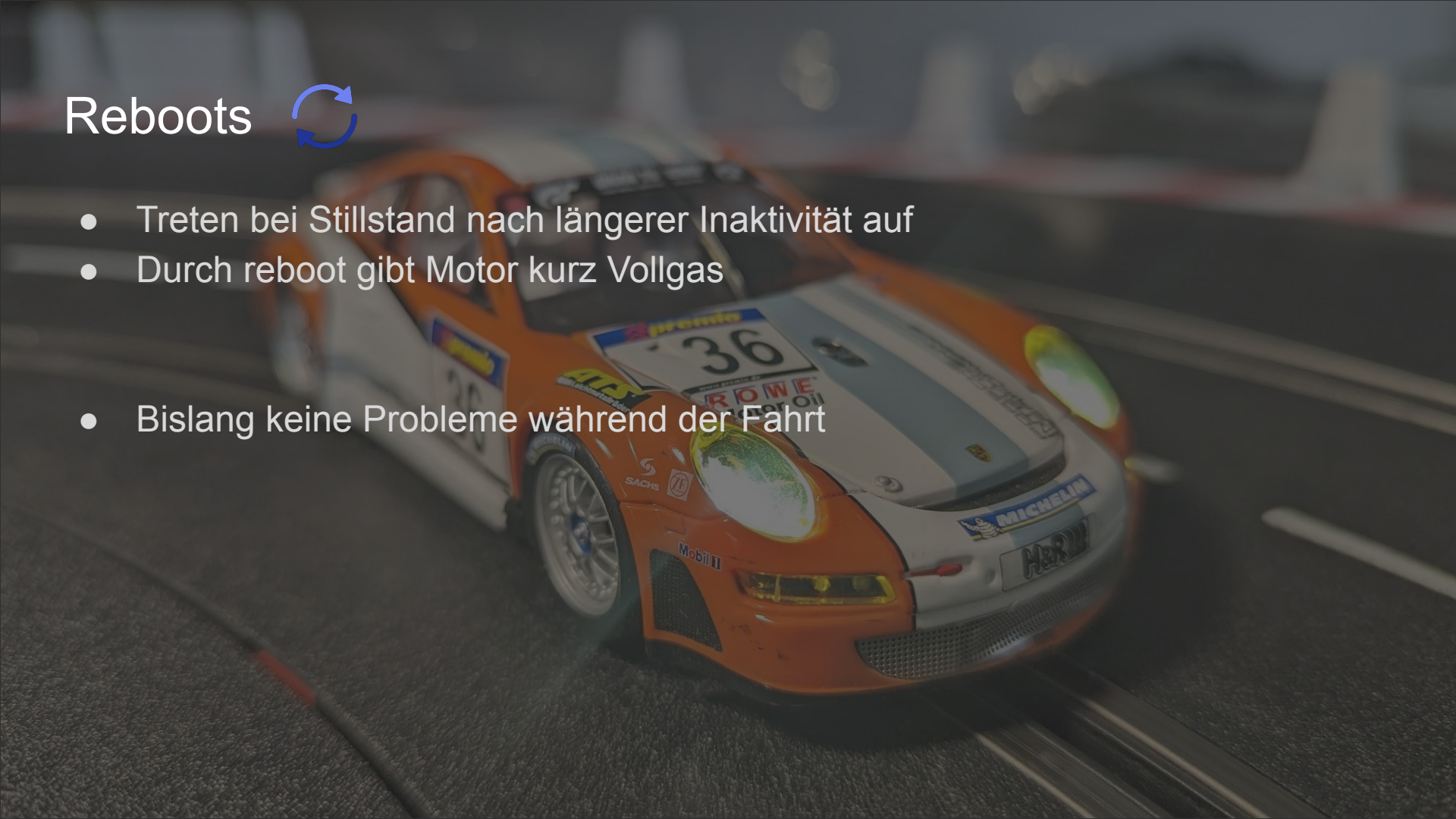



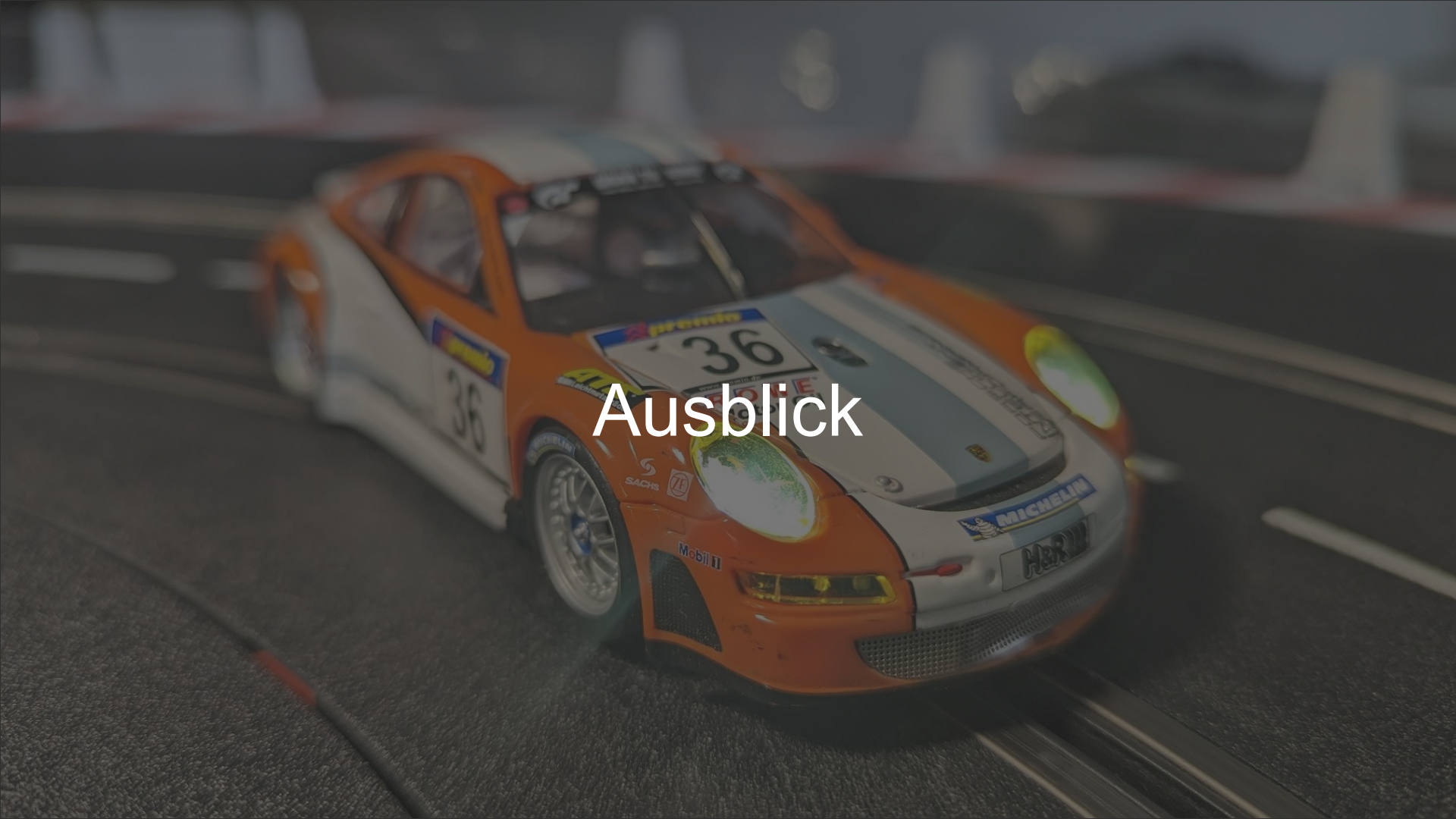



# Reboots

- Treten bei Stillstand nach längerer Inaktivität auf
- Durch reboot gibt Motor kurz Vollgas

- Bislang keine Probleme während der Fahrt

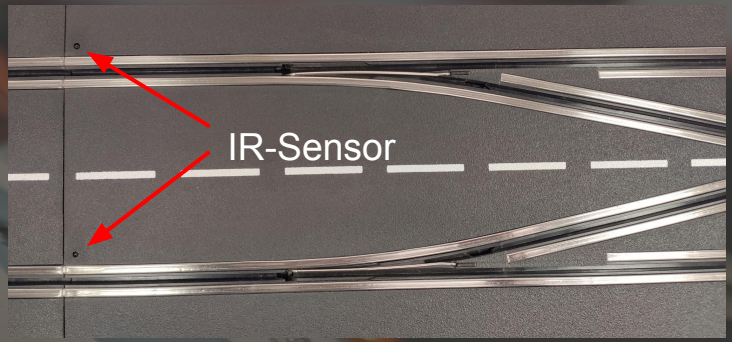





# Ausblick

# IR-Led

- Wichtiges Feature (für Spurwechsel)
- Feature (Code) bereits implementiert
- Schwierig zu testen




Lösungsideen:

- Led einzeln testen
- Andere Leds ausprobieren

# Controllerunterstützung

- Erweiterung der Steuerungsmöglichkeiten
  - ggf. Gangschaltung simulieren

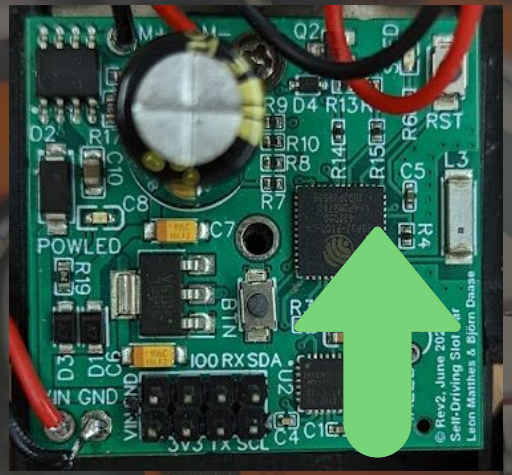


https://resource.logitechg.com/w_692.c_limit.q_auto.f_auto.dpr_2.0/d_transparent.gif/content/dam/gaming/en/products/pro-racing/pro-racing-pedals/gallery/gallery-1-pedals.png

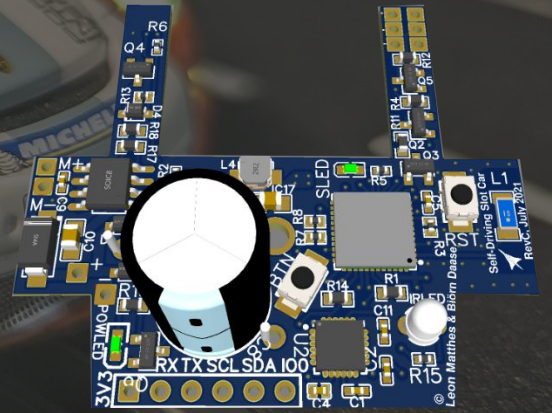
Joycon: https://gzhls.at/i/73/65/2387365-n0.jpg

# Weitere Ideen


Kamera am Auto befestigen




Revision 2 ausbessern




Revision 3 fertigstellen

# See you on the race-track

Bild: https://i.etsystatic.com/6483153/r/il/8a196c/3340635668/il_680x540.3340635668_j15x.jpg