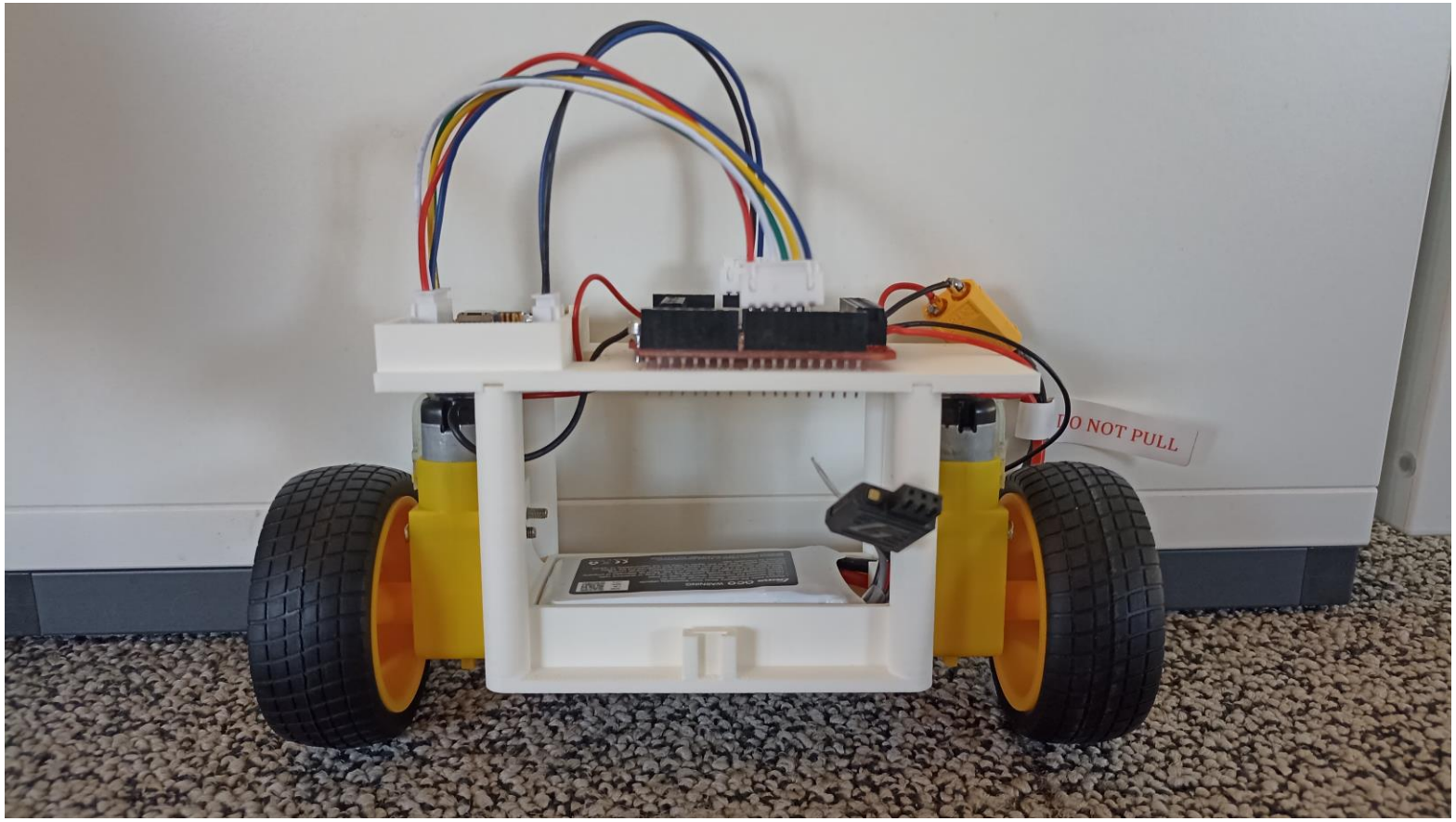
EESTEC Challenge 2025

Improving the PID from a Self Balancing Robot

23.04.2025



EESTEC Challenge 2024

1. Optimize the PID Controller (Balance)
2. Enable Movement (Mobility)

We brought:

Sensor & actuator

Code Examples

Support Team

Task 1: Optimize the PID Controller (Balance)

Optimize the PID controller so that the self-balancing robot (SBR) remains stable in a fixed position without falling over.
The goal is to achieve precise and robust balance, even when exposed to minor external disturbances (such as nudges or a sloped surface).

Evaluation Criteria:

Stability: How well does the robot maintain its balance?

Response Behavior: How quickly and smoothly does it react to disturbances?

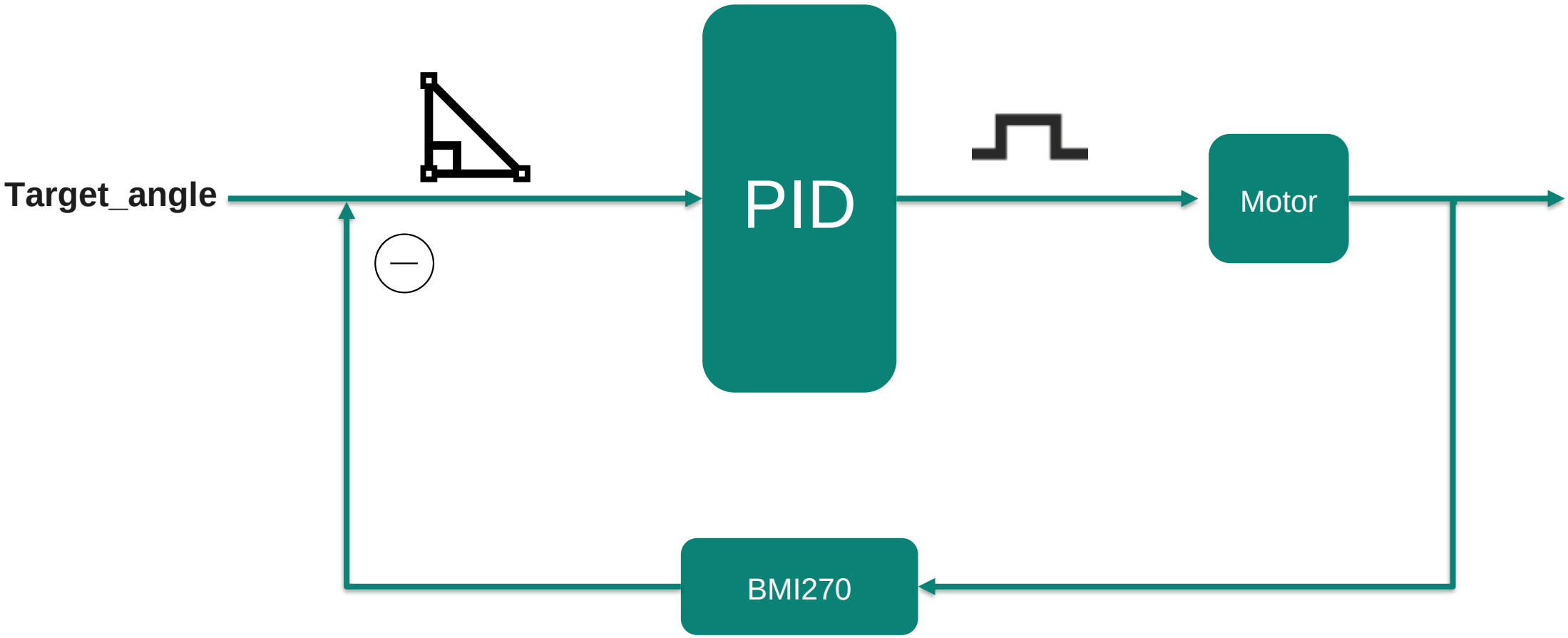
PID Tuning: Clear and well-thought-out parameterization of the PID controller.

Implementation Tips:

Start with small P and D values to observe basic behavior.

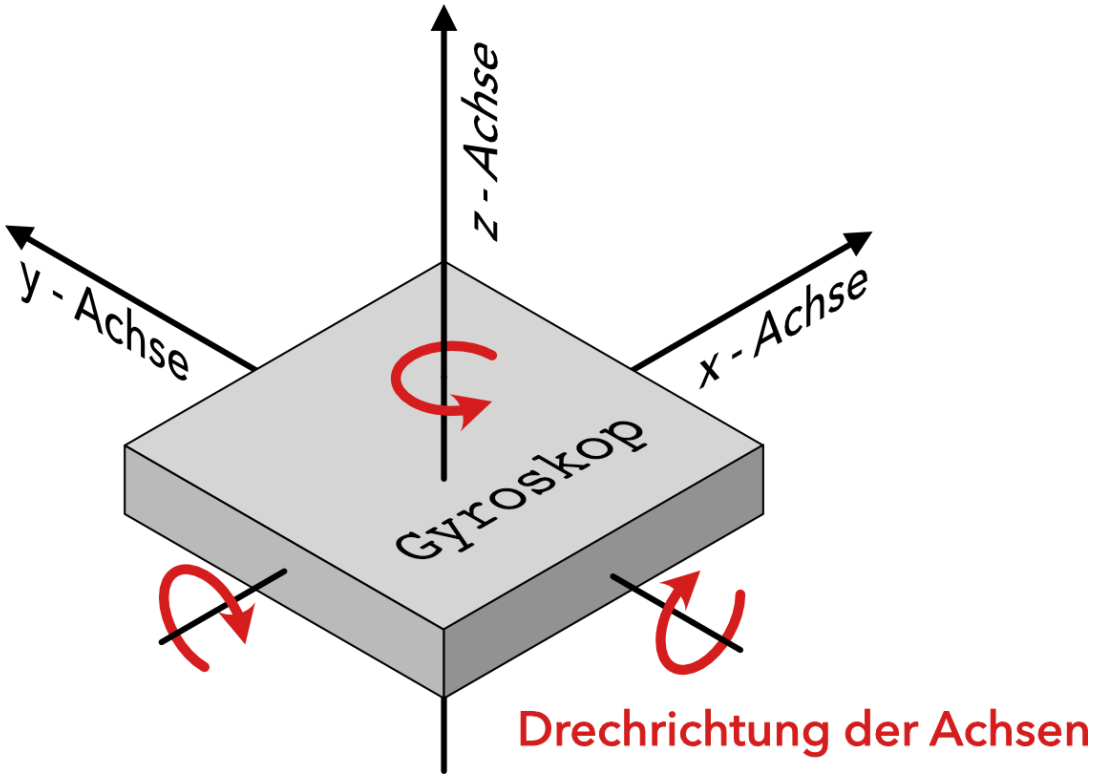
- Use logging (e.g., via serial output) to analyze the controller's behavior.

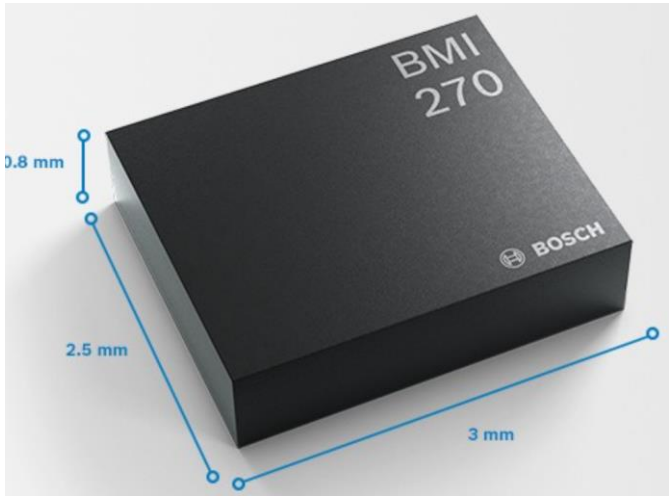
Task 1: Optimize the PID Controller (Balance)



Task 1: Optimize the PID Controller (Balance).

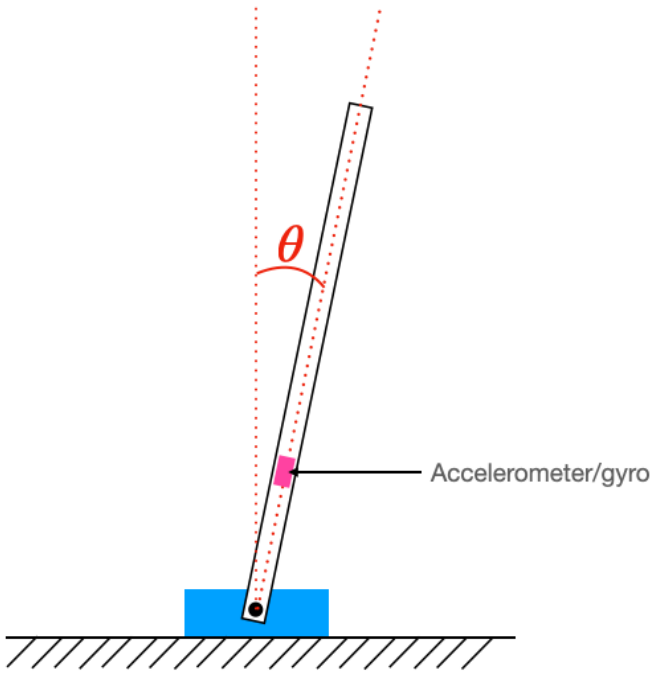
– Gyroscope Sensor: BMI270





Task 1: Optimize the PID Controller (Balance)

– Gyroscope (BMI270) feedback values: ax,ay,az, rx, ry, rz



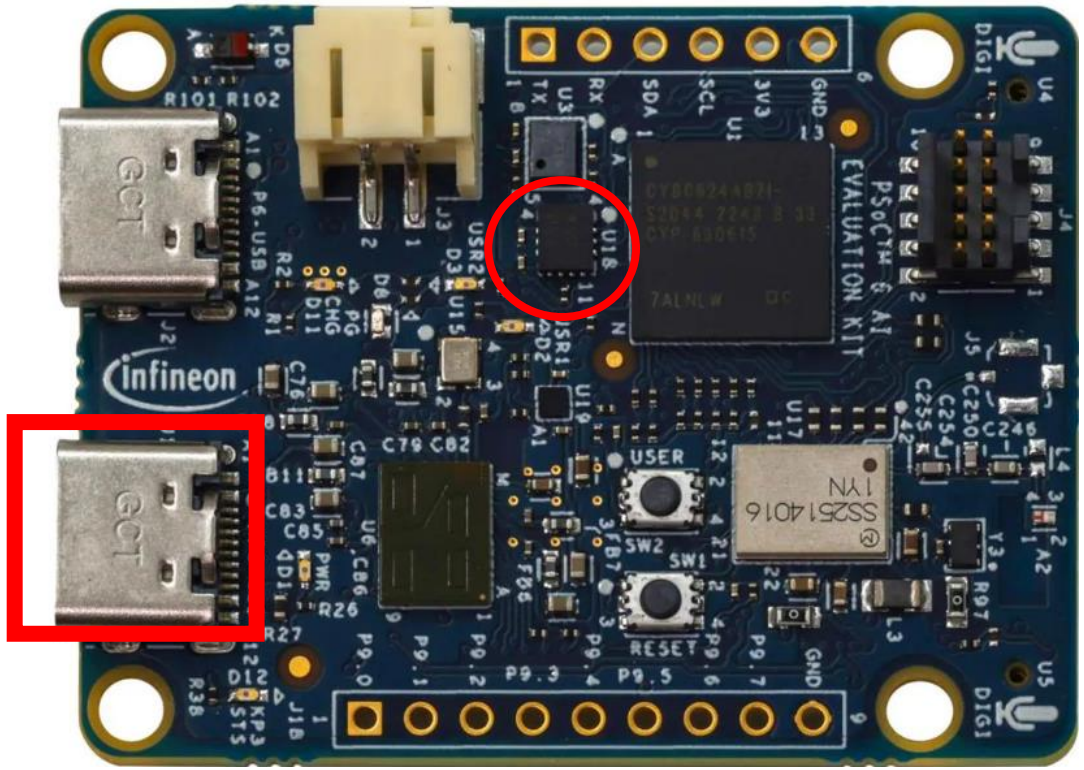
Task 1: Optimize the PID Controller (Balance)

- Motor controller: TLE94112

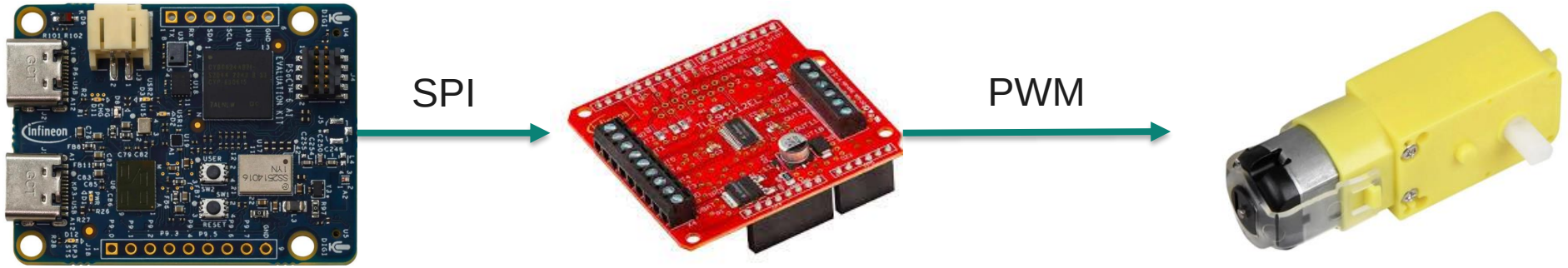
- Multi-Half-Bridge
- 12 Half bridges
- Communication protocol: SPI

Task 1: Optimize the PID Controller (Balance)

– CY8CKIT-062S2-AI with BMI270



Task 1: Optimize the PID Controller (Balance)



Task 2 Enable Movement (Mobility)

Extend the robot so that it can move safely and in a controlled way—forward, backward, and in curves—while maintaining its balancing ability at all times.

Evaluation Criteria:

Mobility: Clean, repeatable movements in all directions.

Balance During Movement: No falling over or excessive wobbling.

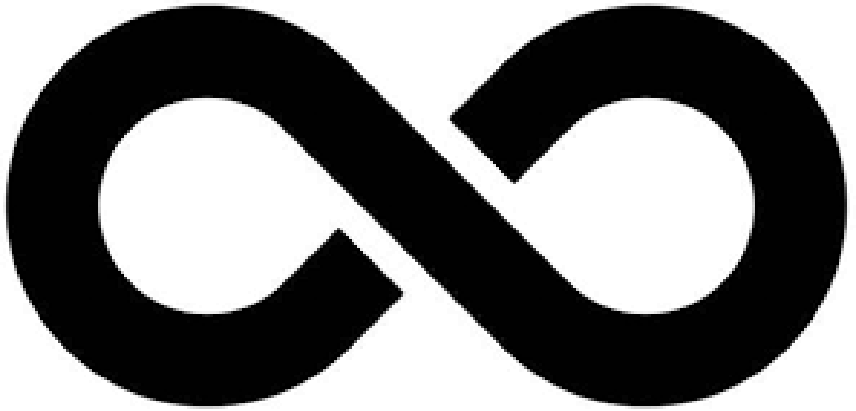
User Control (optional): Possibility for manual control (e.g., via remote control or app).

Implementation Tips:

- Ensure that setpoints (e.g., tilt angle or target position) are dynamically adjusted.

Task 2 Enable Movement (Mobility)

– Move forward, backward, left, right.



Some Hints

- You may use any code you find in the Internet, but please provide the source
- You can use Chat GPT, Copilot, ….
- You can create complete new code (you don‘t have to rely on the example)
- Helpful links:
  https://github.com/Infineon/arduino-core-psoc6
  https://www.hackster.io/Infineon_Team/psoc-6-meets-arduino-the-ultimate-maker-combo-9fc127
  https://www.bosch-sensortec.com/products/motion-sensors/imus/bmi270/
  https://github.com/Infineon/multi-half-bridge

Judging Criteria

Criteria	Comment	Weight
Task 1	• Task 1 Is the SBR stable? 25% Does it move when it should be still? 15% How does the SBR on sloped or inclined planes? 10%	50%
Task 2	• Can it move forward (5%), backward (5%), left(5%), right (5%), and stays stable?	20%
Documentation	• Write an article about you project. Explain your and your thinking. You can post it on hackster, github or write an word document. (Please let us know where we find an this article).	20%
Feedback	Please provide feedback to us. You can write the feedback on github or send it to us via e-mail (ericjoerg.schulze@infineon.com)	10%

Let‘s Get Started!

github.com/Infineon/hackathon

Submission

- Submission happens on **Google Drive.**
  - You will receive an individual upload link for your team from EESTEC

Deliverables

- A **technical article**, including:
  - **Idea** description
  - Reproducible step-by-step guide on **technical implementation**
  - Overview of **project outcome**
  - **Outlook** for future improvement
  - Format can be **Markdown** or **PDF**
  - Including **graphics/pictures** is appreciated
- Your documented **code**
  - As ZIP archive in Google Drive **or**
  - Private repo on **GitHub** -> invite julian.eder@infineon.com and ericjoerg.schulze@infineon.com
- A short presentation (5 minutes)
- Your **Feedback** about the challenge: **What did you like? What would you do differently?**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