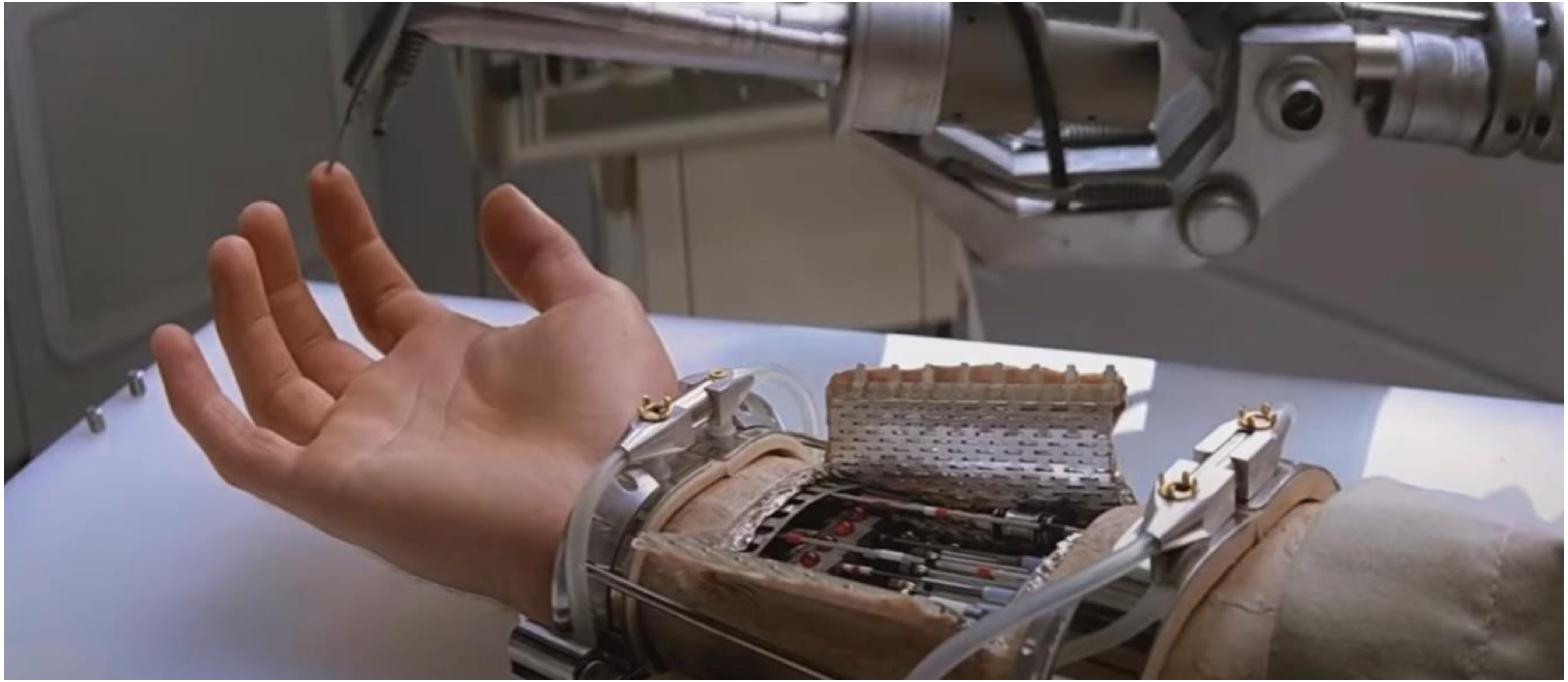


EESTech Challenge Final Round 2025

Touch to Grasp: Smart Grippers with Infineon Magnetic Sensing and Motor Control

14.05.2025

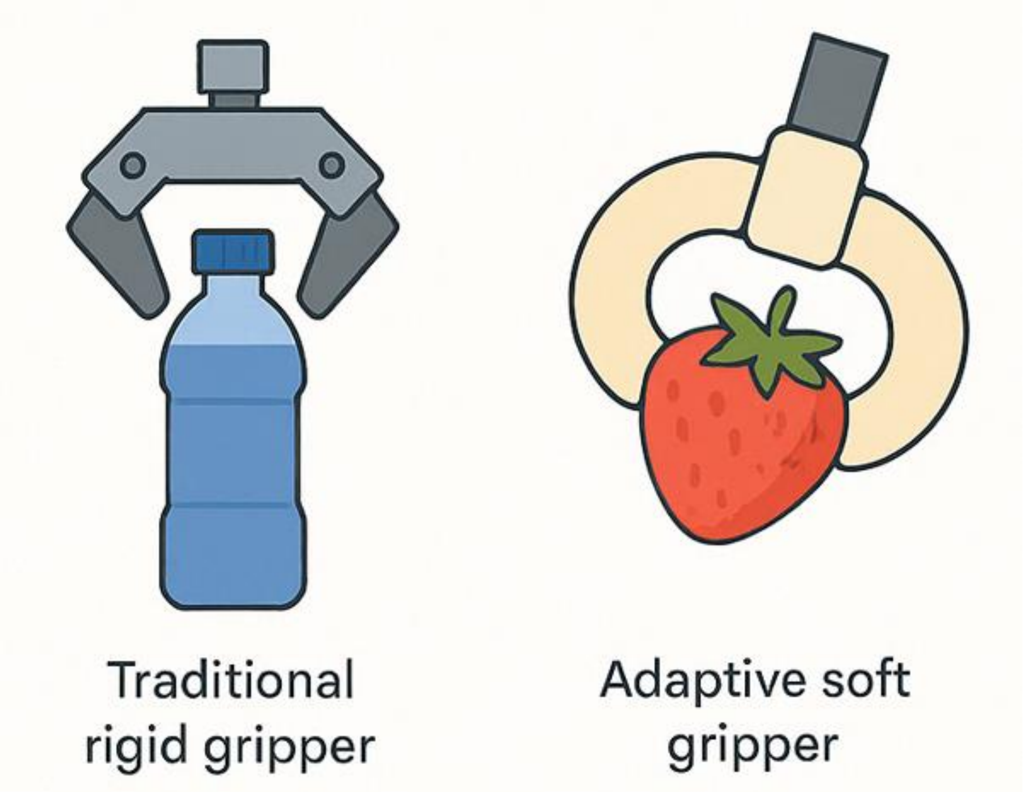
Linjing Zhang

IPCEI Microelectronics and Communication Technologies

Infineon

EEStech Challenge Final Round 2025

You‘ll build something that adapts intelligently – like a human hand.
The robotic gripper can detect contact, measure force, adjust grip automatically, responds to human actions…
That‘s not just cool – it‘s the future of human-robot interaction!



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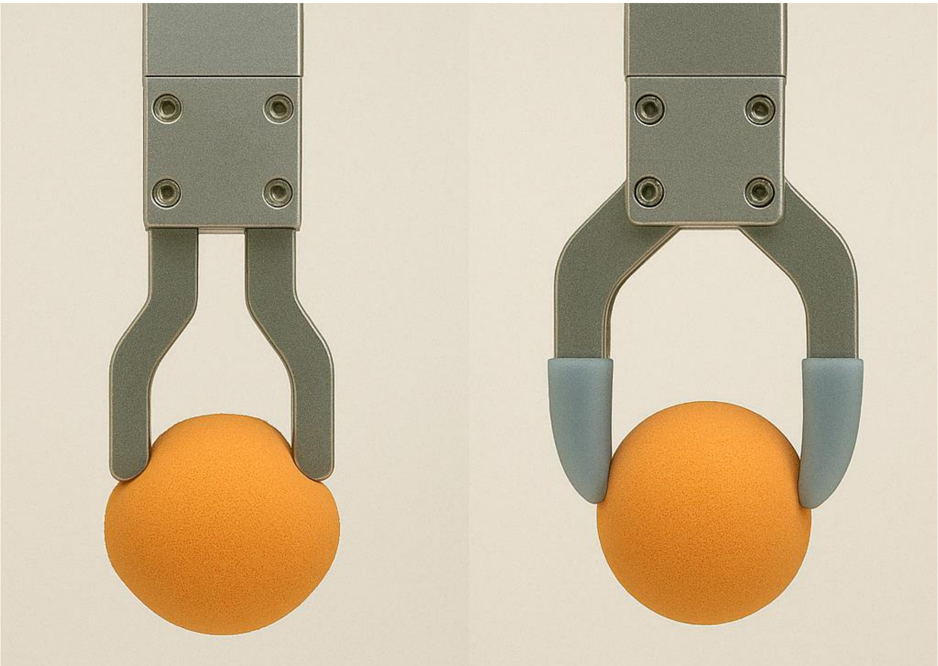
Project Overview

Design and implement a control system a smart robotic gripper equipped with soft silicon skin embedded with magnetic sensors. Use a Brushless DC (BLDC) motor to actuate the gripper, ensuring precise control for grasping, holding, and releasing objects of varying sizes and weights. The gripper should automatically adjust its grip to handle both soft objects and hard object without damage.



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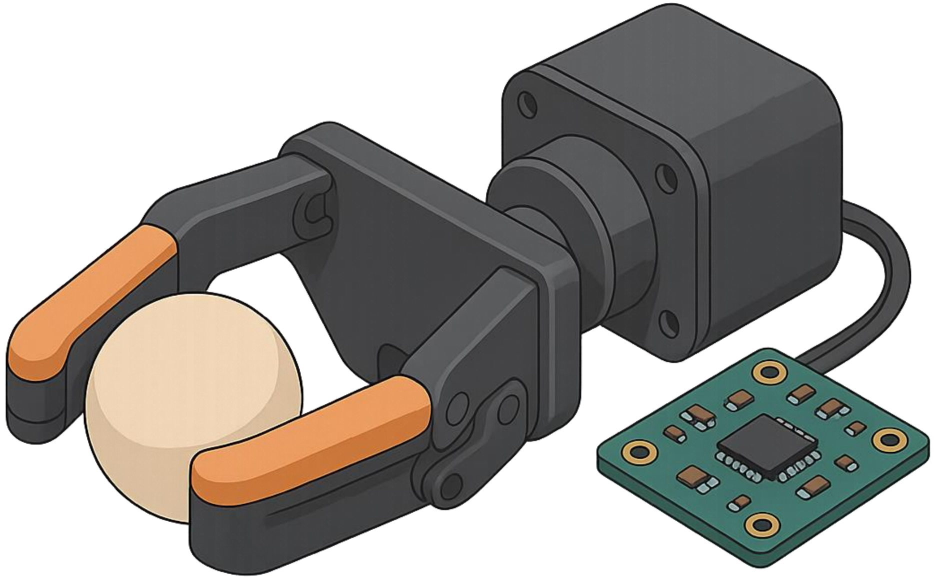
Key Features

- **Compliant gripping** using tactile feed back
- **Magnetic sensing** silicon skin
- **F**ield **O**riented **C**ontrol of BLDC motor
- Real-time adaption: **Don't break balloons or let heavy pieces of metal fall**

- Bonus: UI, object classification, auto grip tuning....



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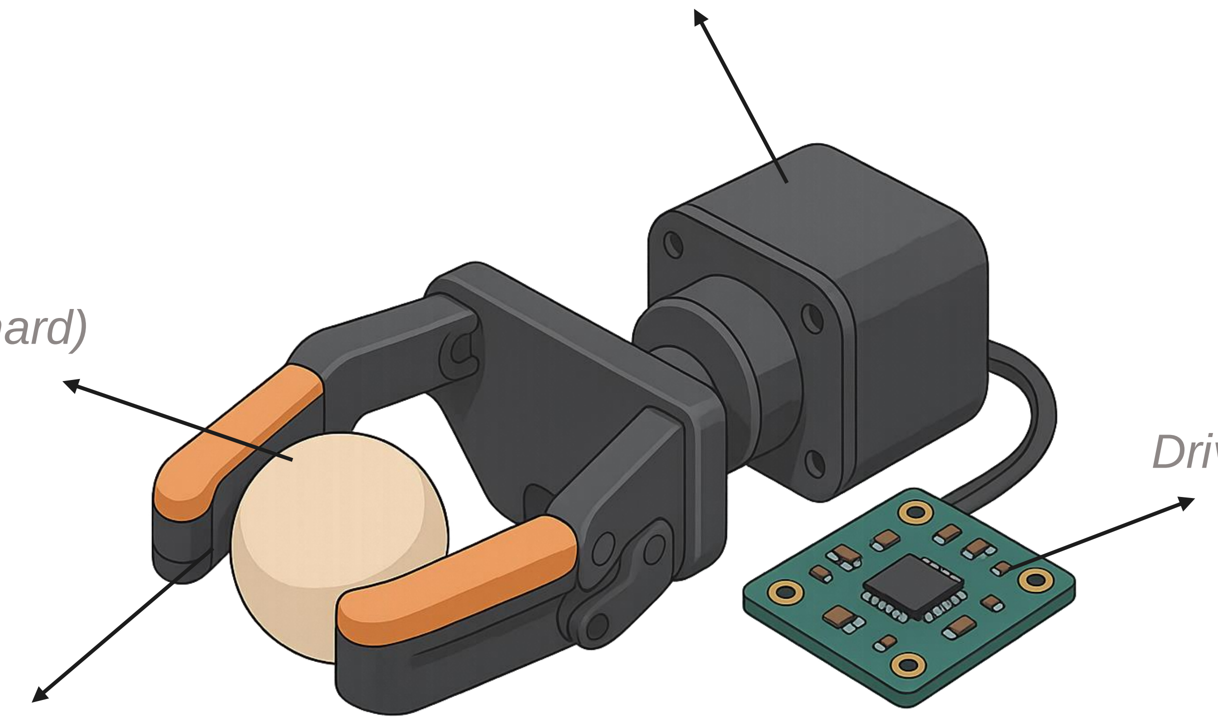
System Components

With pre-assembled hardware and ready-made libraries, you can skip the boring stuff and dive straight into solve real robotics problem.



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System Components

Hardware

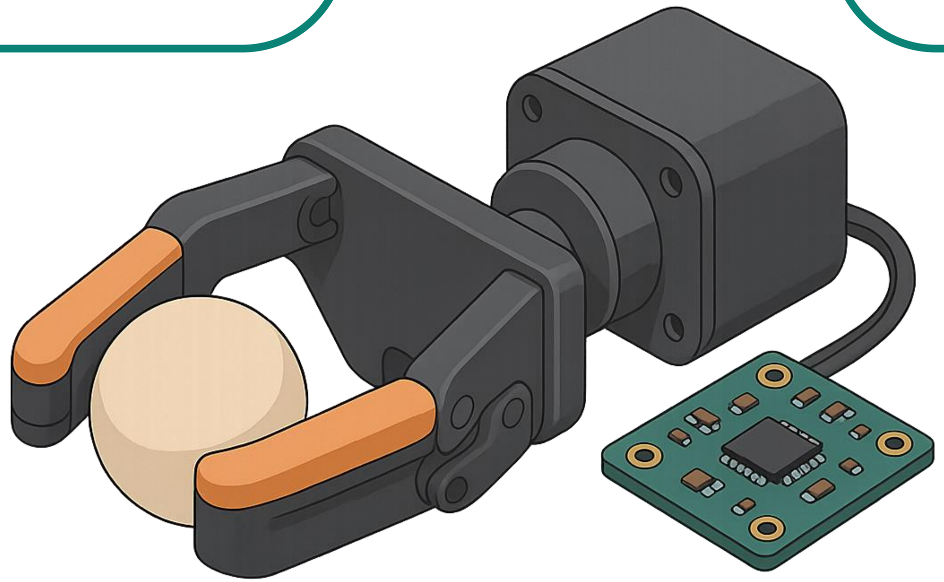
A ready-to-use robotic gripper

- Soft 3D Magnetic Sensor TPU Skin
- Actuators: a BLDC Motor
- BLDC Shield and angle sensor
- Control Board XMC4700

Software

Arduino capable BSP and libraries

- XMC4Arduino
- Simple FOC library
- 3D Magnetic library
- Integration template



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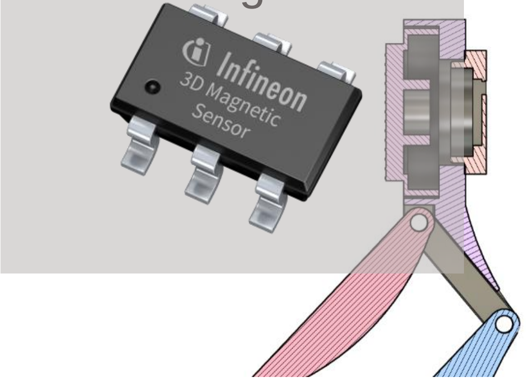
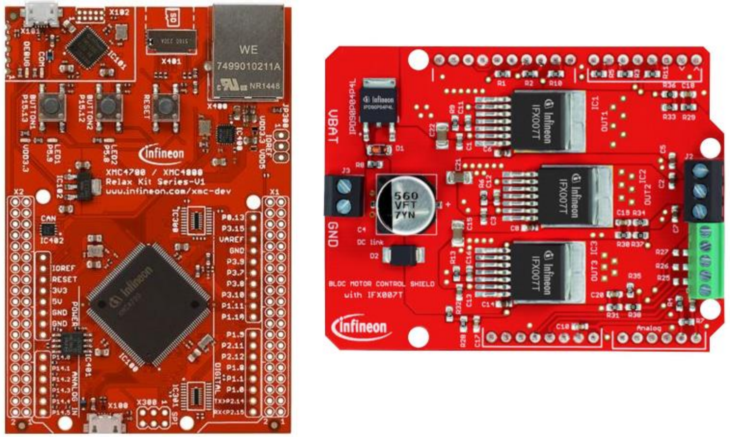
Control Logic

Motor (mechanical part)

TPU + magnet



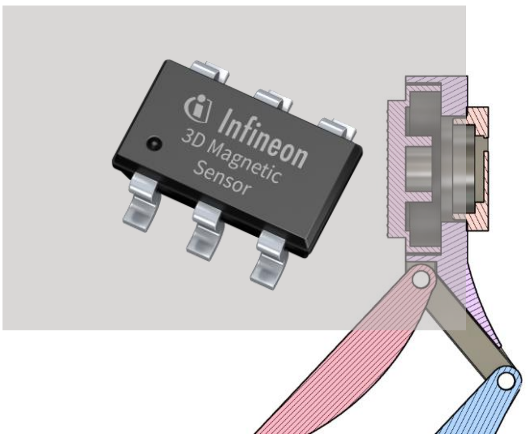
controller & driver

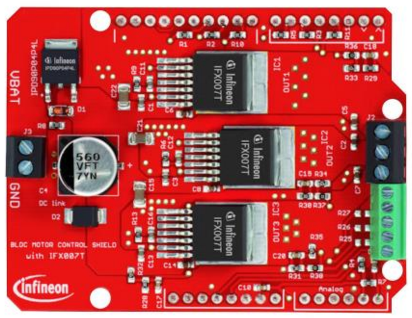


Control Logic

User input

- Star/stop command
- Button
- UI optional
- ....





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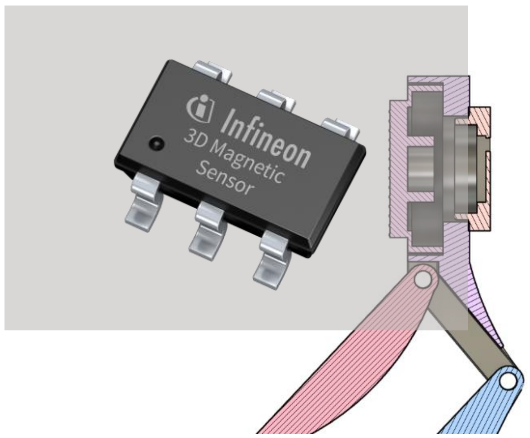
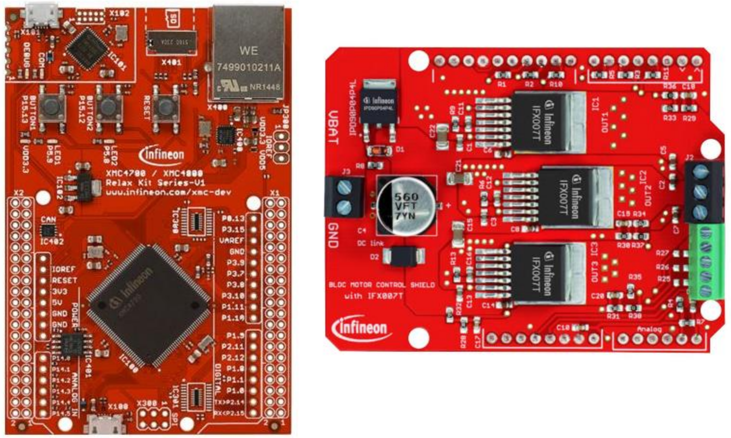
Control Logic

Motor Control Module

- Field-oriented-control (position/speed/current control)
- Dynamically adjust torque or postion based on object





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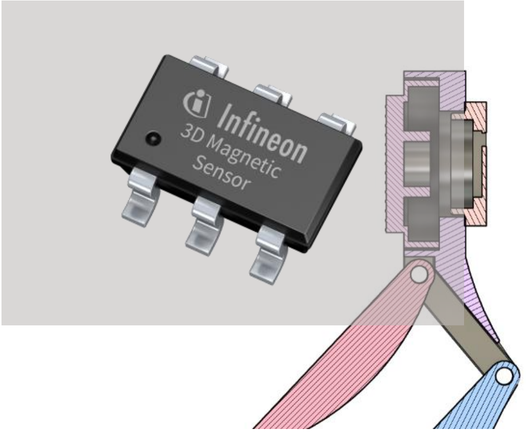
Control Logic

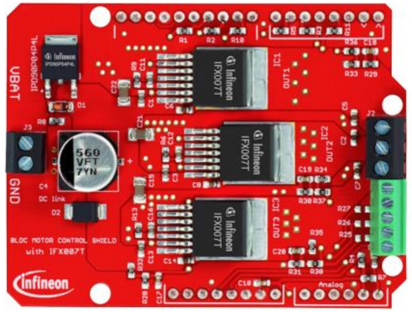
Main Control loop

- Force control based on sensor feedback
- close-and-stop and reopen



Data Processing

- Filtering
- Contact detection
- Force estimation



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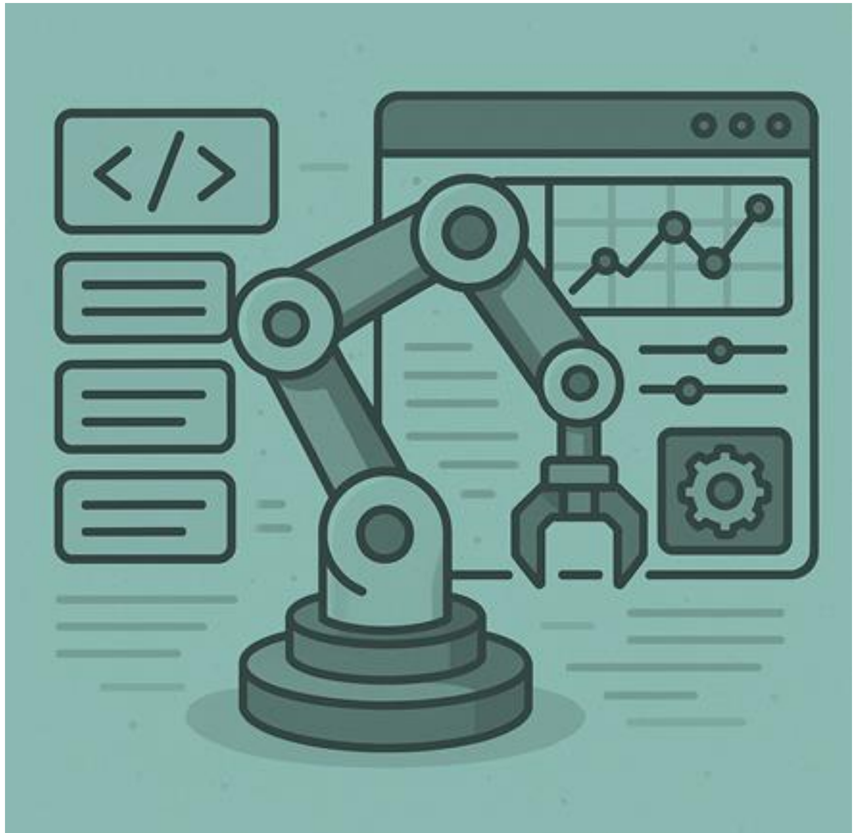
Some Hints

- **Explore Freely**: In addition to tune the PID and build the smart control loop, each team is encouraged to explore more inonovation solution and additional feature: such as user Interaction, mechanical tweaks, adding more sensor/cameras... You are not limited (only by physics)!
- The provided example is meant as reference only and should help you get start. Your solution does **not have to be based on this example.**
- You may use any code you find in the Internet, but **please provide the source.**



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Challenge Description

Challenge 1: Control Tuning

It’s hard to manually tune PID values for optimal torque in BLDC motors.
Find the **best PID values** for speed and position control by maximizing pressure using feedback from the 3D magnetic sensor, to improve smoothness, accuracy and stability of control loop.
Think about **automating this fine-tuning** process.

Challenge 2: Smart Control

Go beyond simple control loop, implement a **smarter, adaptive control strategy using sensor feed back.**

- Adjust grip force dynamically
- Identify object softness/hardness
- smart grip and release
- ….

Submission

– Submission happens on Google Drive
  – Each team must submit a **single-page PDF** before the the submission deadline, that includes
    – GitHub Repository Link
    – Brief Project Description
  – Please make sure:
    – Your GitHub repo is public or access is shared with judges for submission.
    – Your PDF file name follows this format **TeamName_ProjectName.pdf**

Deliverables

– **Single-page PDF**
  – No content restrictions, as long as GitHub link is clearly visible
– **GitHub Repository**
  – Contain full project code and documentation
  – All commits must be made before deadline

– **Live Demonstration** of the Smart Gripper
– A **5-10 minute pitch** presentation
  – **Idea** description
  – Overview of **project outcome**
  – Including **graphics/pictures** is appreciated
  – **Outlook** for future improvement
  – Please upload the presentation file afterwards
– Your **Feedback** about the challenge: **What did you like? What would you do differently?**
  – enter #1238795 on Slido and note your group name in Feedback

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Judging Criteria

Criteria.-	Comment	Weight
Challenge Completion	• Challenge 1 (PID fine-tune) (20%) *Smooth and precise control* *Automatic tuning* • Challenge 2 (Smart control) (40%) *Adaptive control: Hard /Light and fragile/ heavy/ round object* *Smart Response and Control*	60%
Algorithm	• Code Quality (5%) • Documentation (10%)	15%
Innovative Techniques	• How innovative is the implementation and use of technologie • How challenging is the technical implementation	10%
Presentation & Demo	• Lead us through your team's journey during the Hackathon • Explain the outcome, implementation and its value • Show us a live demo!	15%
Feedback	• Provide feedback about the challenge • ...and about the organisation	Extra 5%

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Let‘s Get Started!

github.com/Infineon/hackathon

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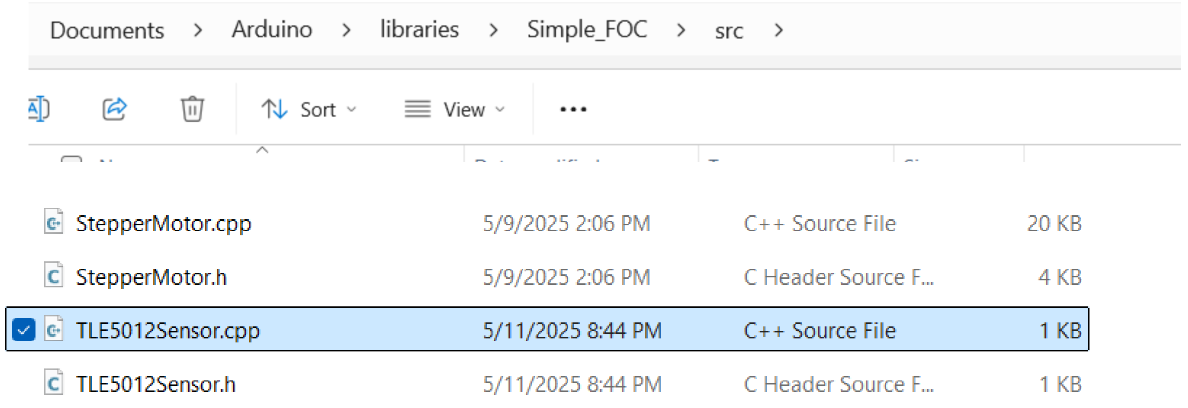
Hints

- Install the beta version for better performance UART communication: https://github.com/LinjingZhang/XMC-for-Arduino/releases/download/V3.5.3-beta/package_infineon_index.json
- Move the angle sensor wrapper class in SimpleFOC library path:



- Check the README/ comments in sketch for more details of how to run the example code.

Reference

– Meta AI Reskin : https://ai.meta.com/blog/reskin-a-versatile-replaceable-low-cost-skin-for-ai-research-on-tactile-perception/
– ReSkin: versatile, replaceable, long-lasting tactile skins, Bhirangi et al., 2021
– SimpleFOC: https://docs.simplefoc.com/
– Soft Robotics Toolkit: https://softroboticstoolkit.com/
– In-Hand Slip-Aware Object Manipulation with Parallel Grippers, Waltersson et al. 2024

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