CONNECTUM

Project Presentation

22 July 2025 @ Etzelstraße 38, TUM Campus Heilbronn

Project Idea

Hardware Architecture

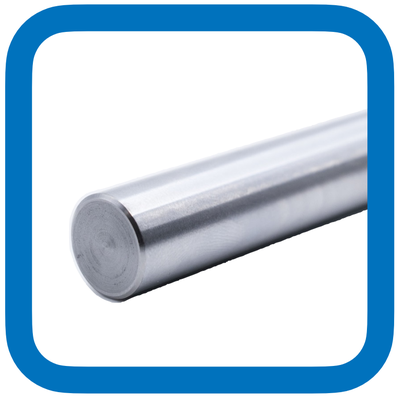
Hardware Architecture

Mechanical Components

Lead Screw

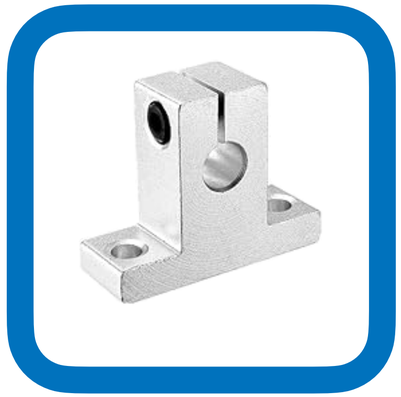
Lead Screw Nut

Pillow-Block Bearings



Linear Shaft

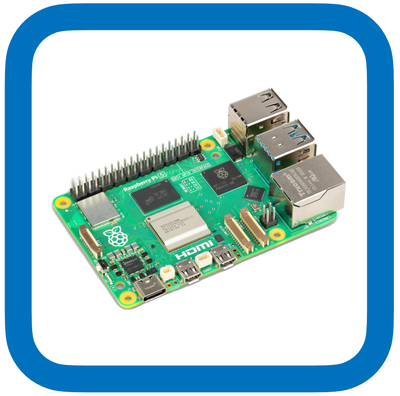
Linear Bearing Block



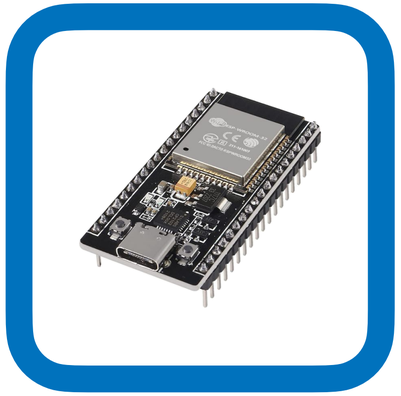
Shaft Supports

Hardware Architecture

Electronical Components



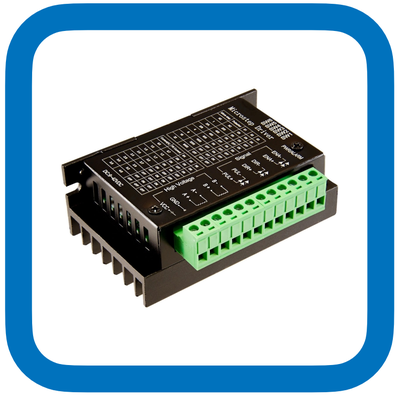
Raspberry Pi 5



ESP32

Servo Motors

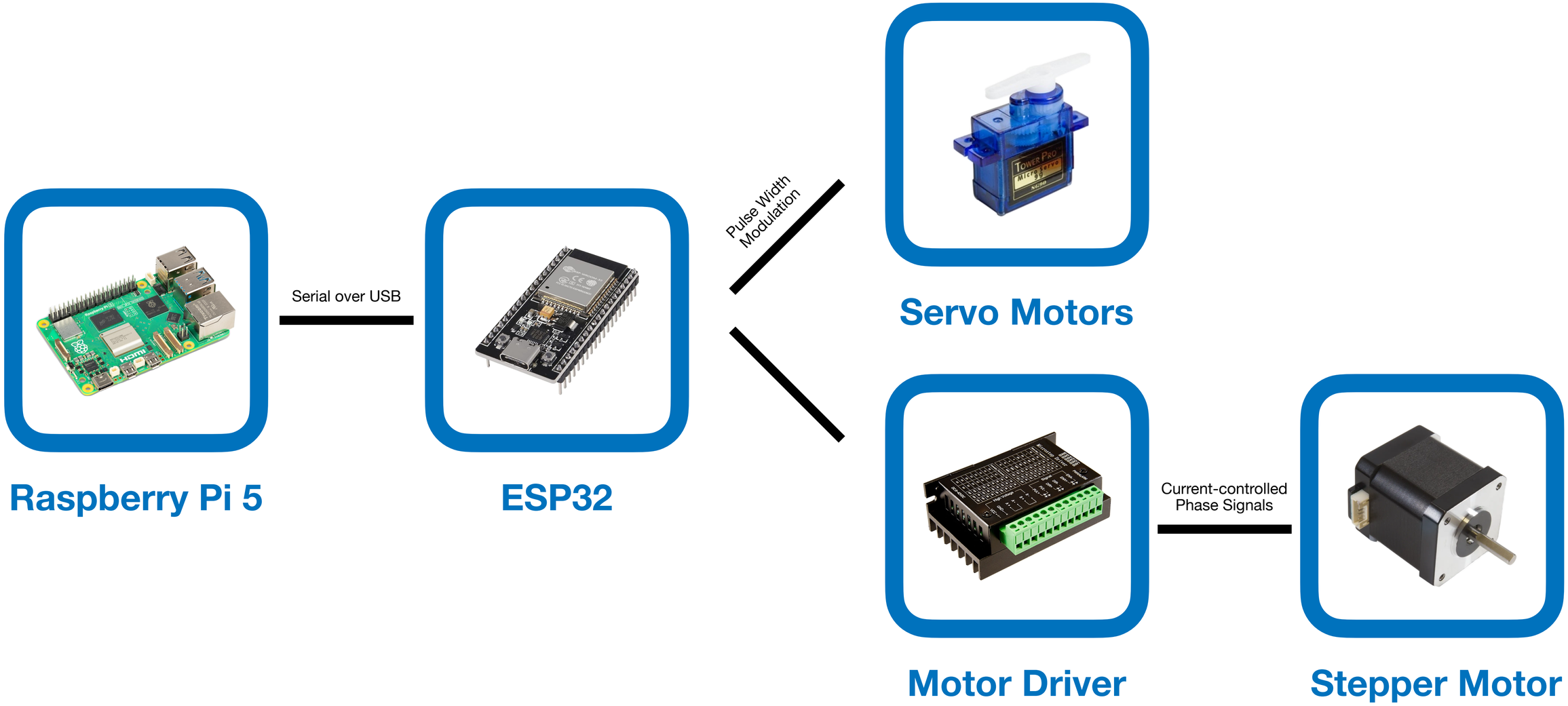
Stepper Motor



Motor Driver

Hardware Architecture

Electronical Schema - Data



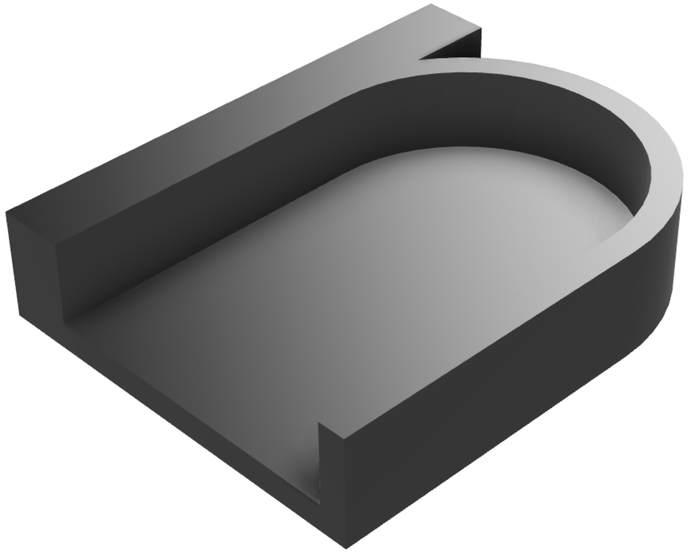
Product Design

Product Design

Core Components

Magazine

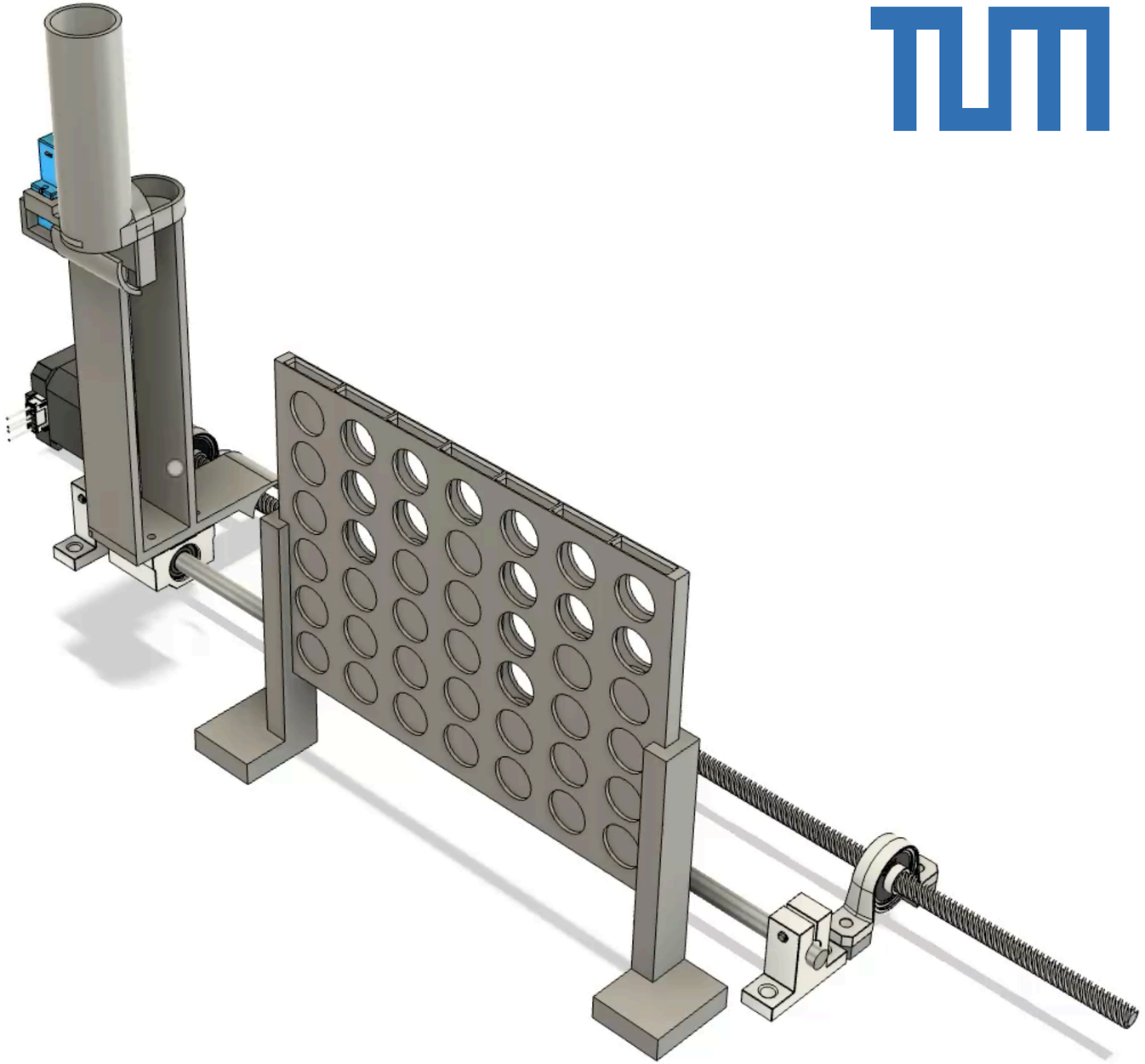
Base



Chip Holder

Product Design

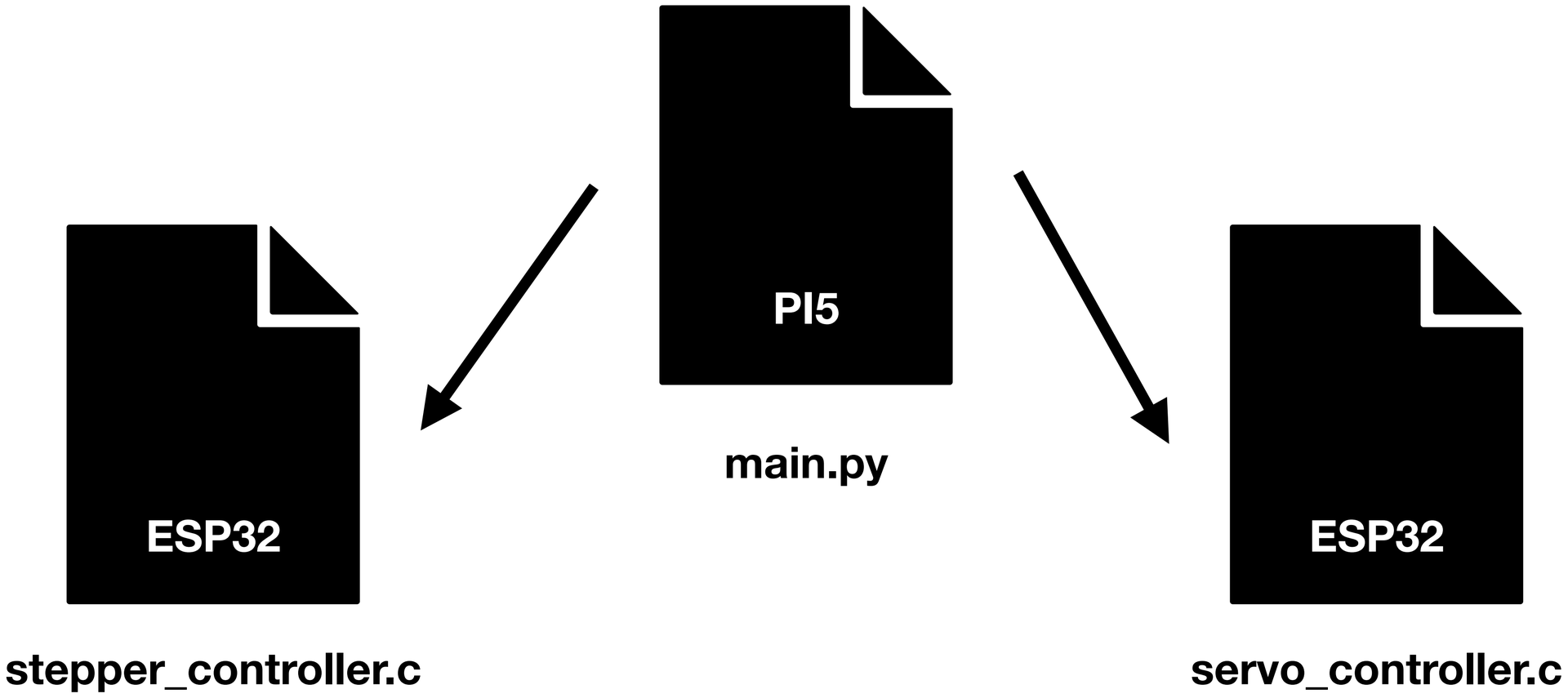
Chip Insertion Mechanism



Software Development

Software Development

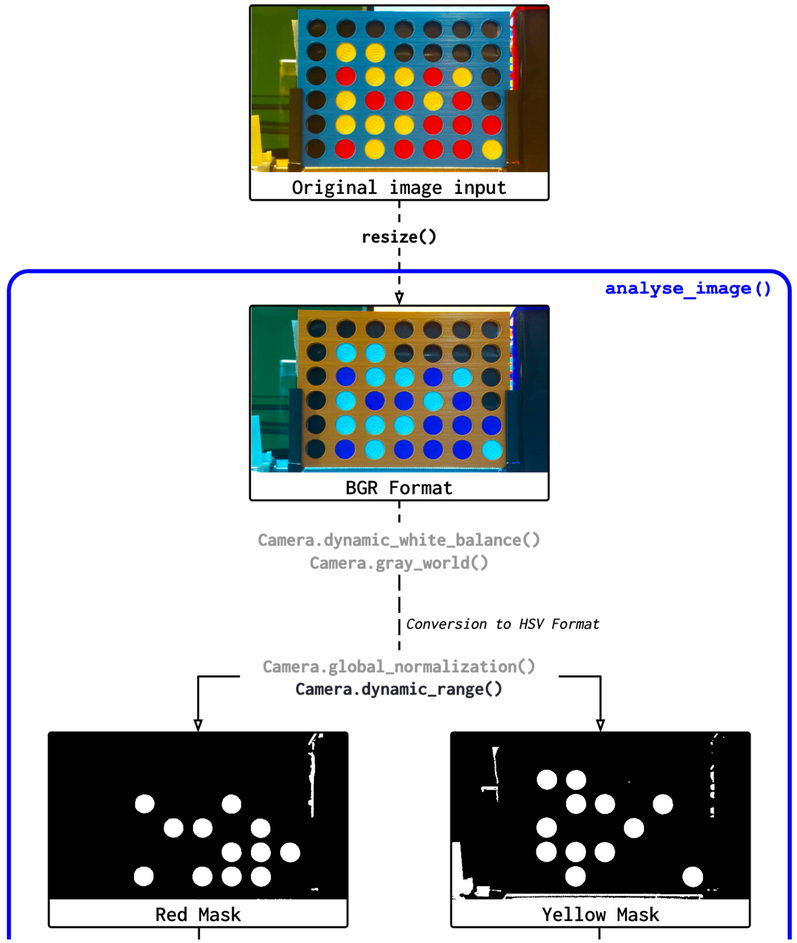
Control Logic

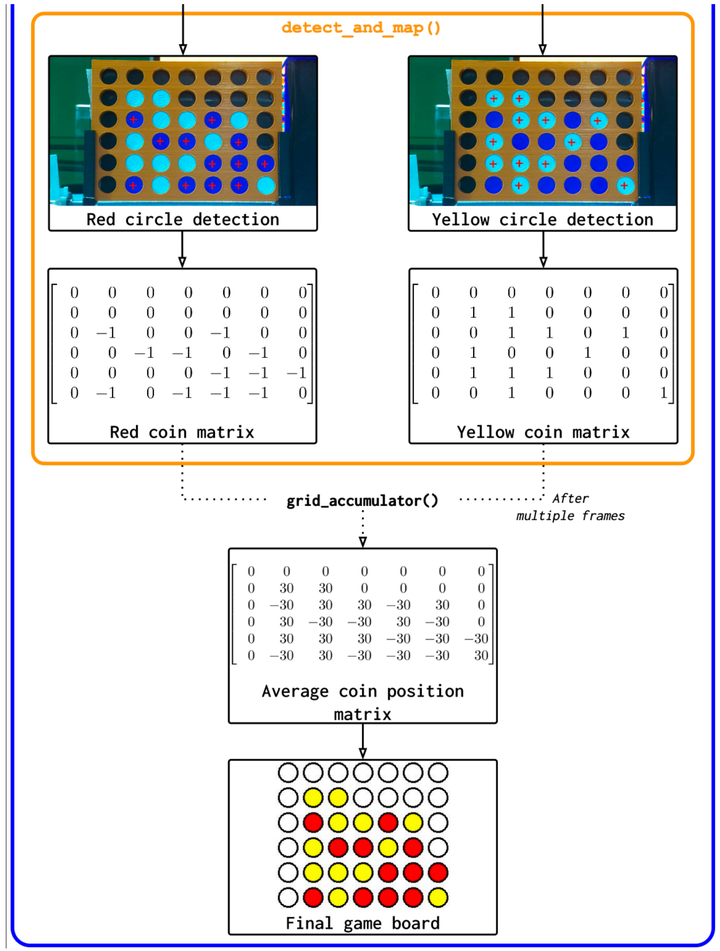


Computer Vision Module

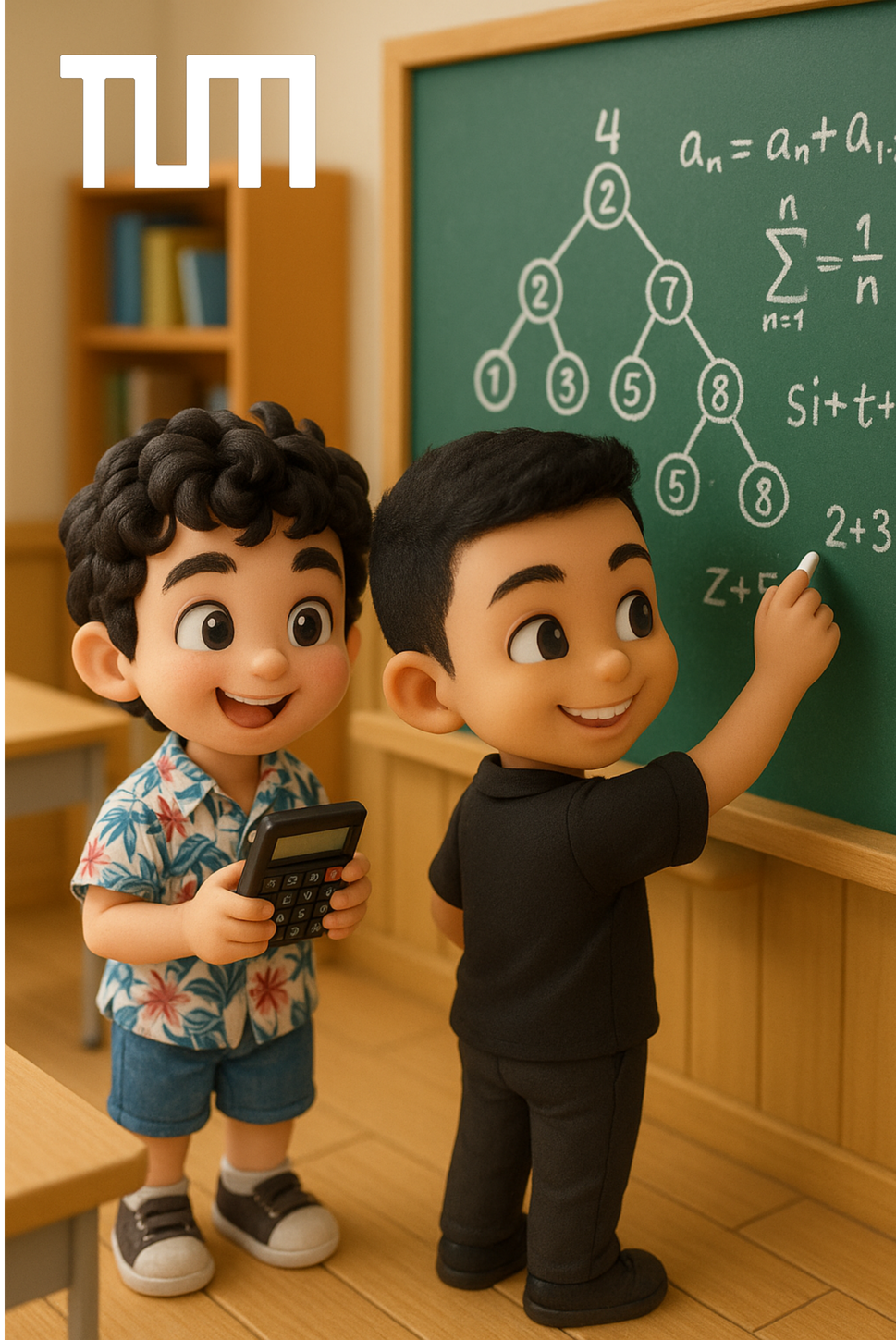
Computer Vision Module

From an image to a state



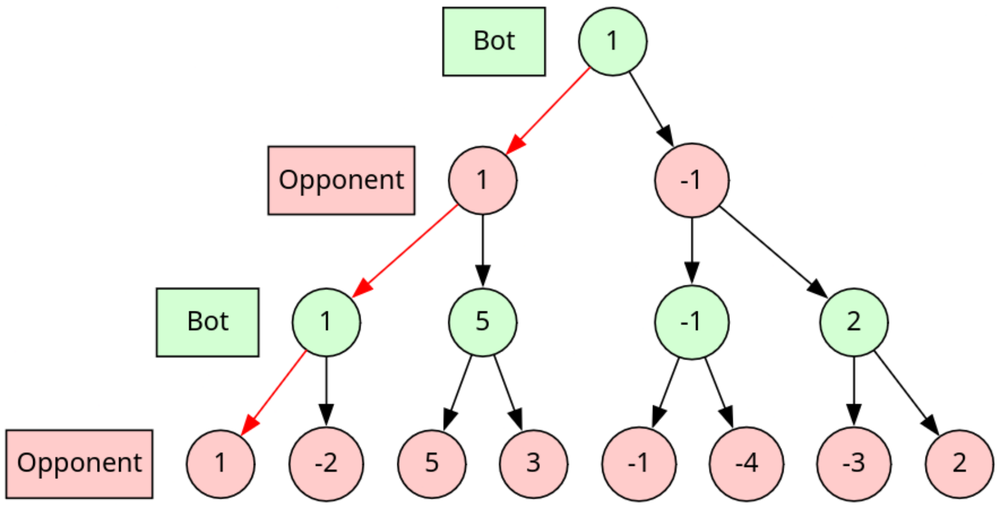


Algorithm Design



Algorithm Design

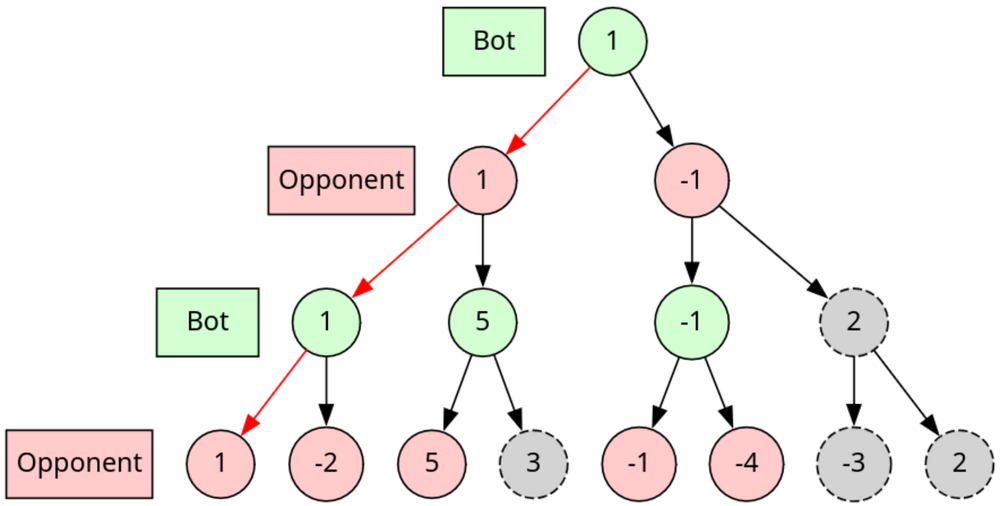
Impossible Mode: Game Tree Search



Minimax

Algorithm Design

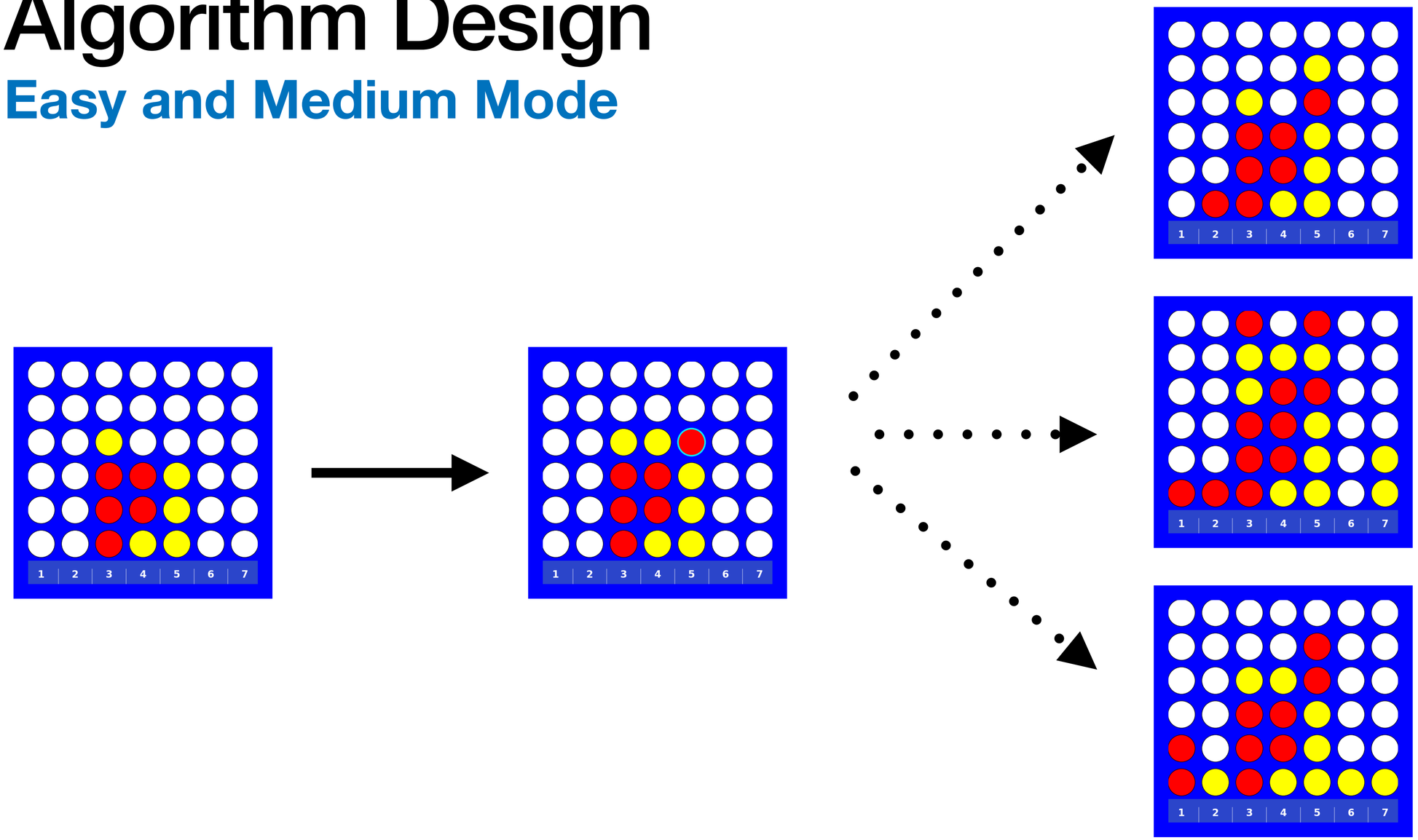
Impossible Mode: Game Tree Search



Minimax with Alpha-Beta Pruning

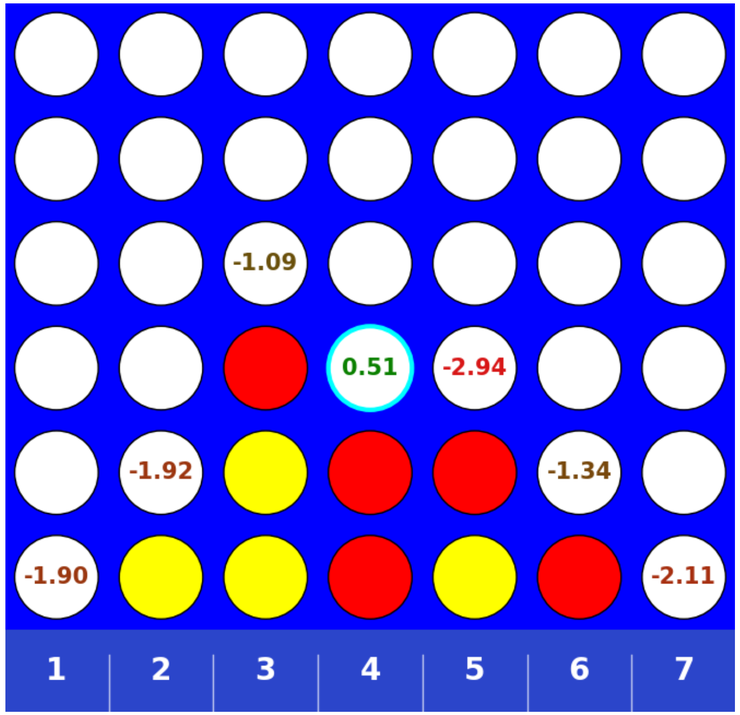
Algorithm Design

Easy and Medium Mode

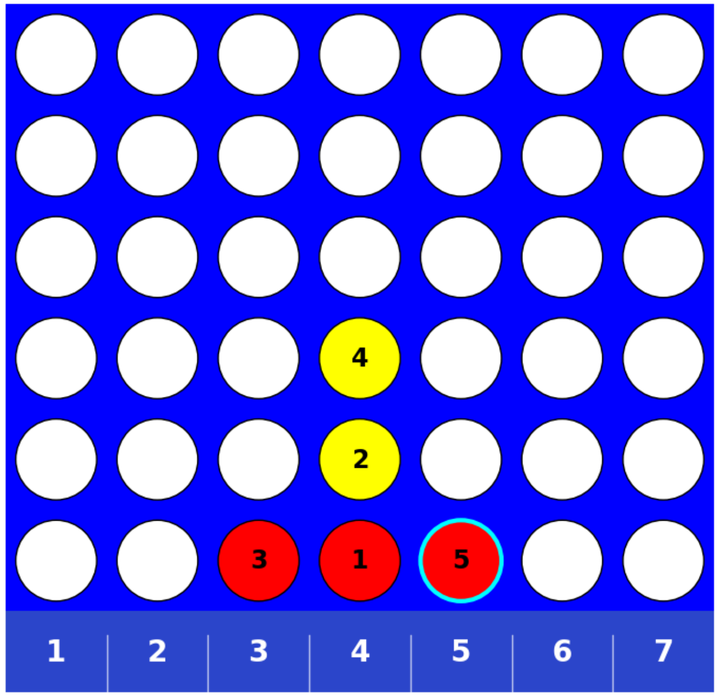


Algorithm Design

Medium Mode: Evaluating The Best Move



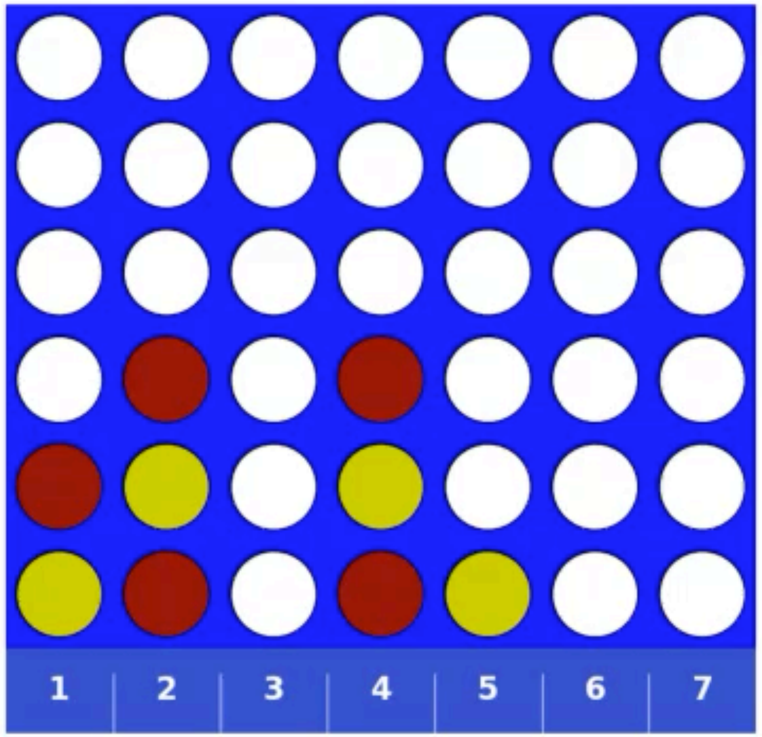
Simulation scores for each column



Double check tactic by red

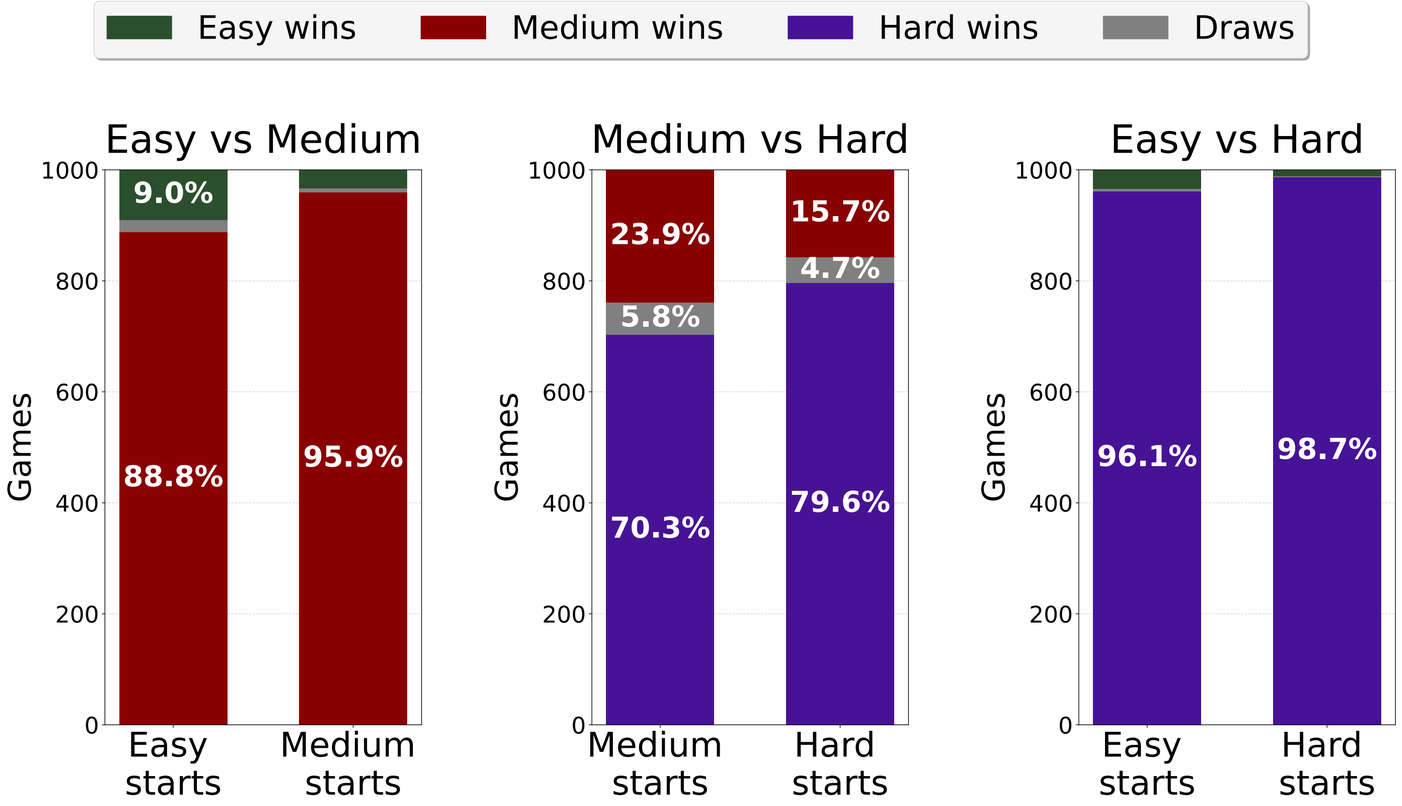
Algorithm Design

Hard Mode



Algorithm Design

Fine-tuning



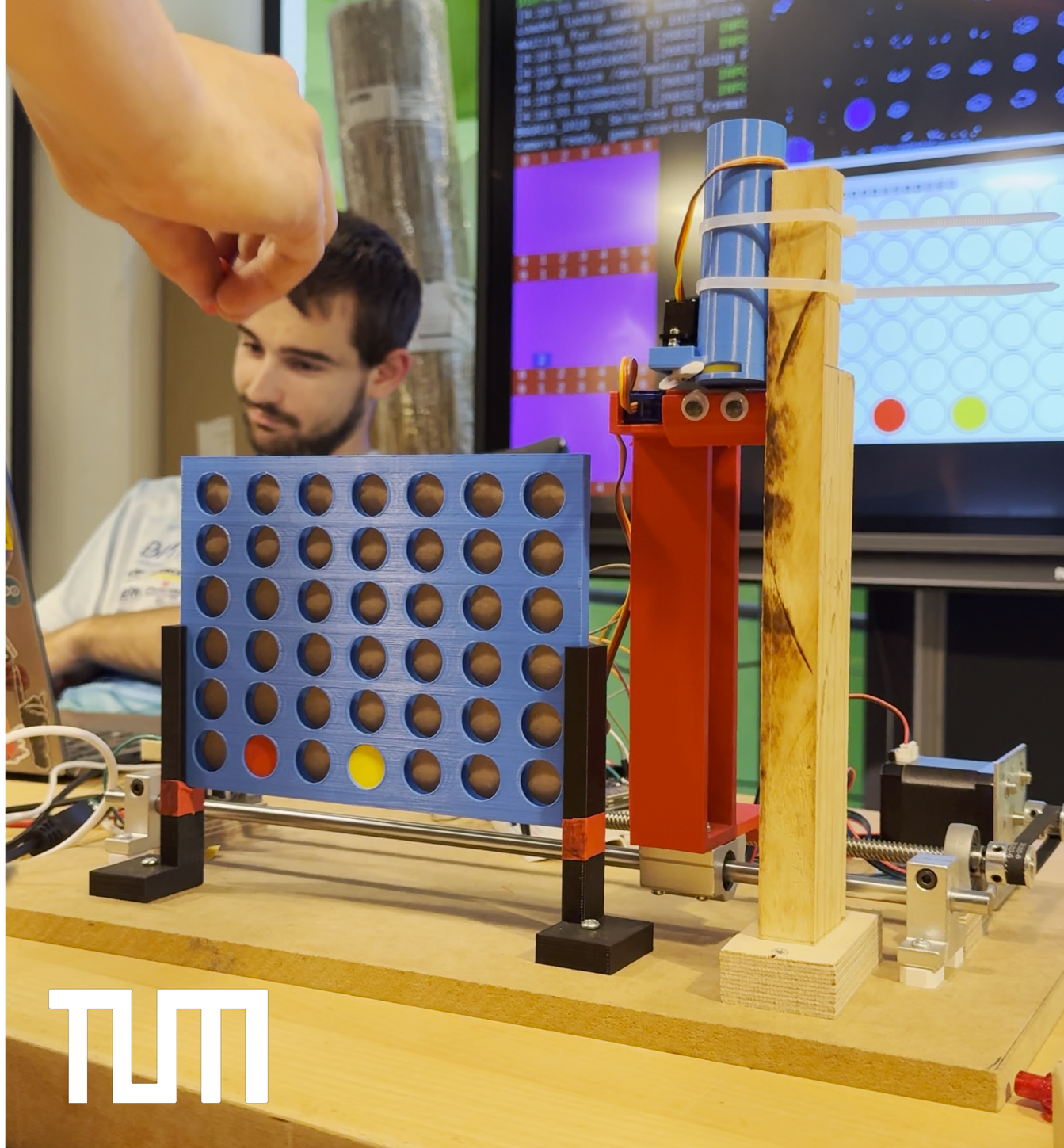
Win rate distribution across levels

Review

Restyling

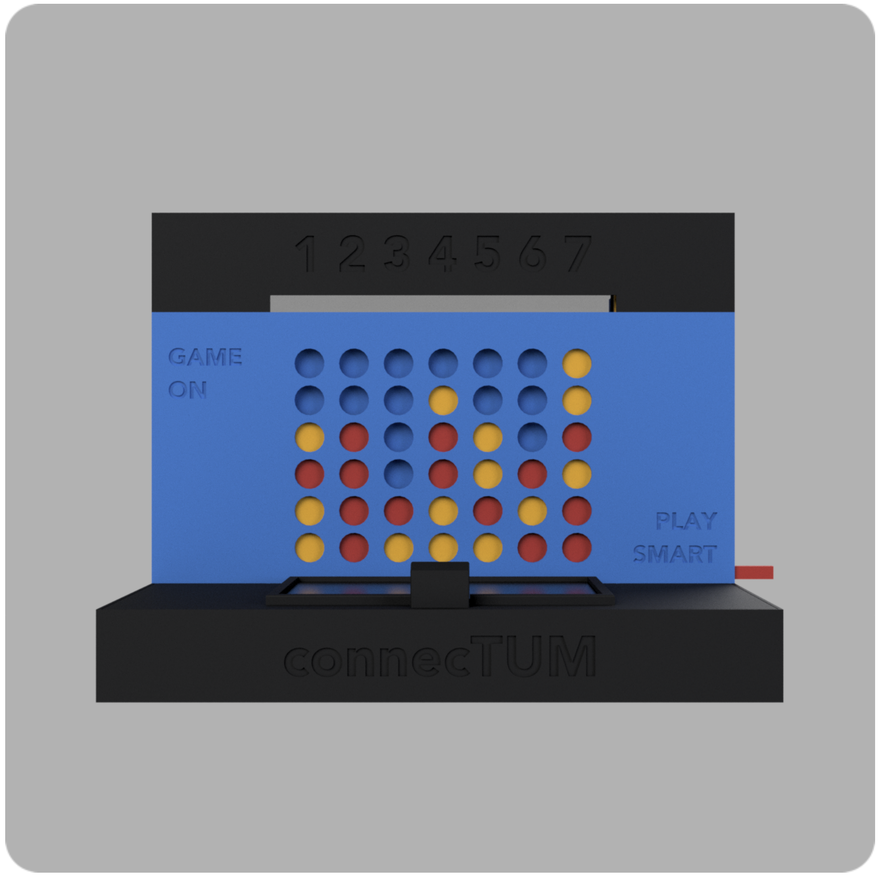
Reasons

- Lack of Game Feedback
- Limited Interactivity
- Fragile Construction
- Low Portability



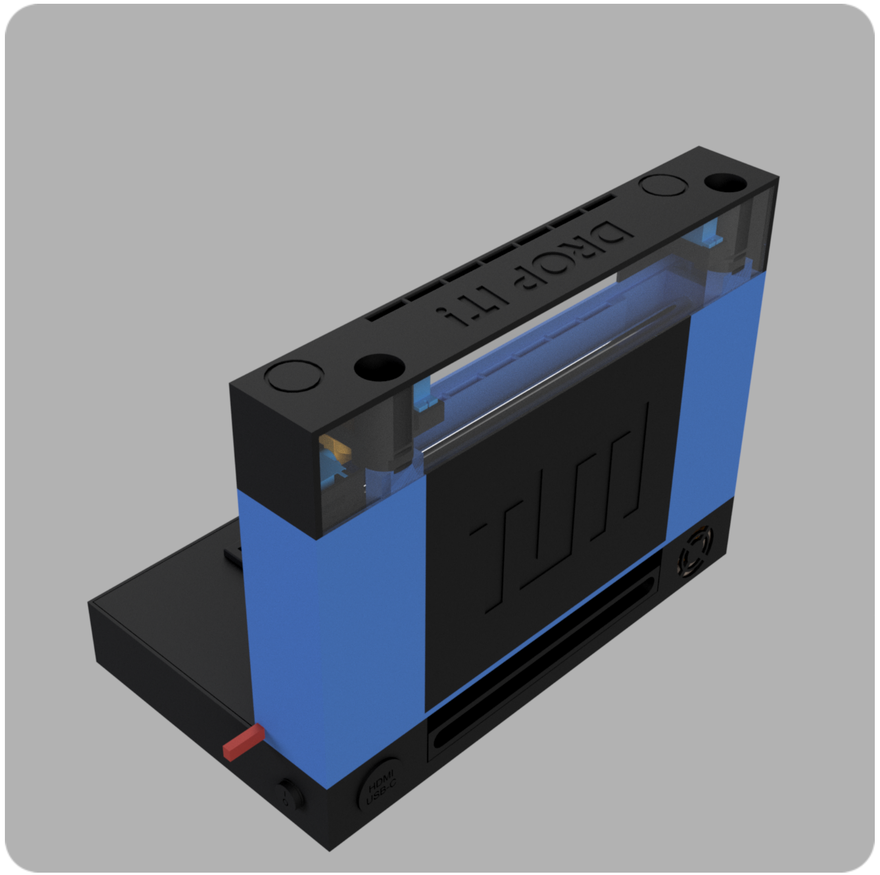
connecTUM 2.0

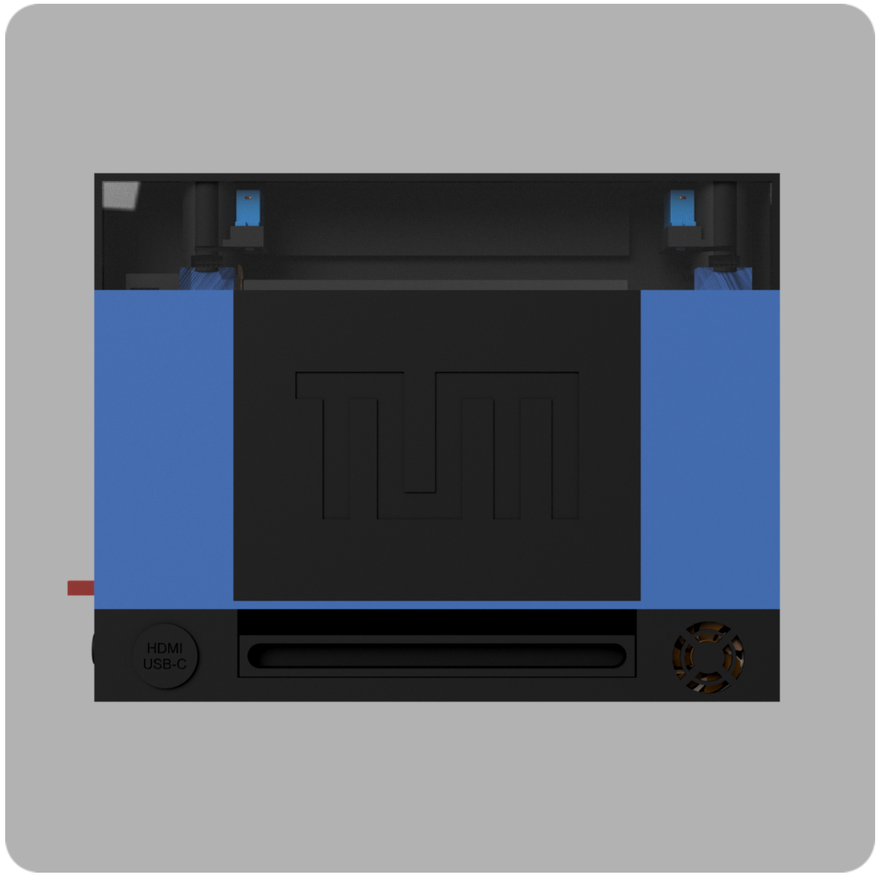
Reinventing Connect 4 — the TUM way



connecTUM 2.0

Reinventing Connect 4 — the TUM way





New Hardware Architecture

Hardware Architecture

Mechanical Components

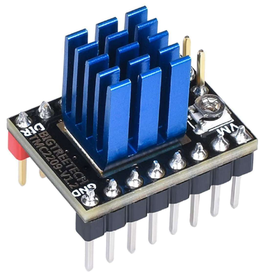
Pillow-Block Bearings

Shaft Supports

Hardware Architecture

Electronical Components

ESP32

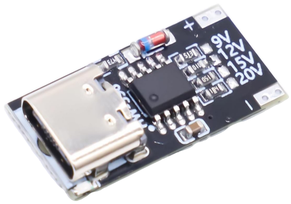


Motor Driver

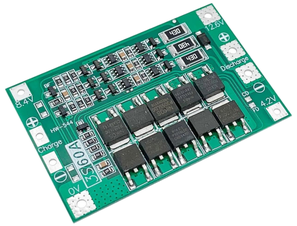
Fan

Touch Display

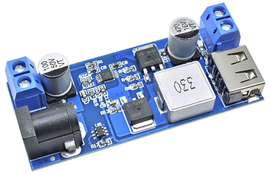
Battery



PD Decoy

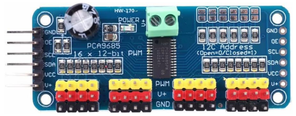


BMS



Buck Converter

I/O Expander

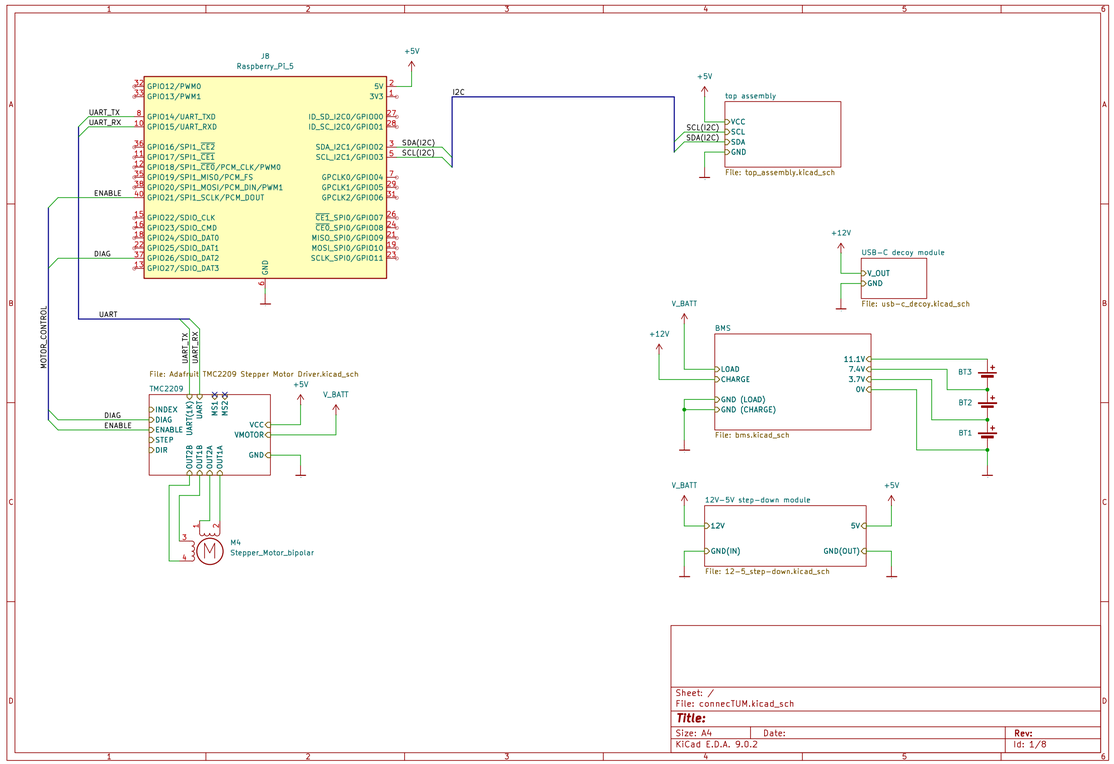


PWM Driver

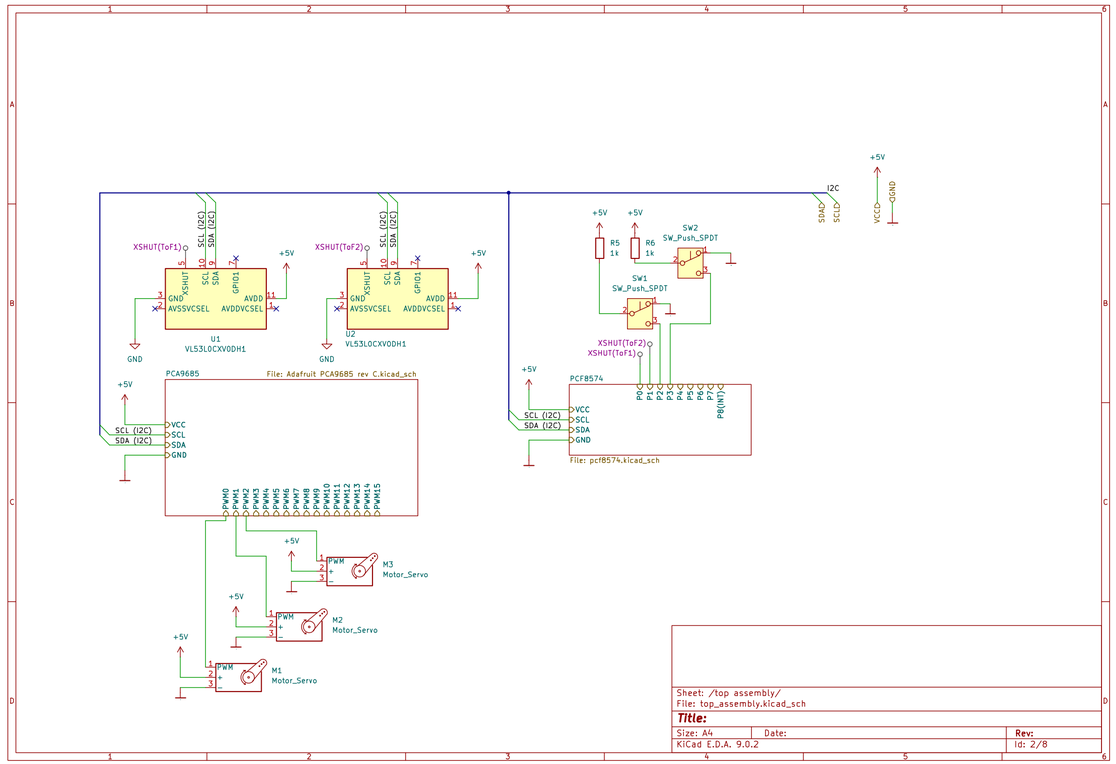
ToF Sensor

Hardware Architecture

Electronical Schema



Bottom Assembly

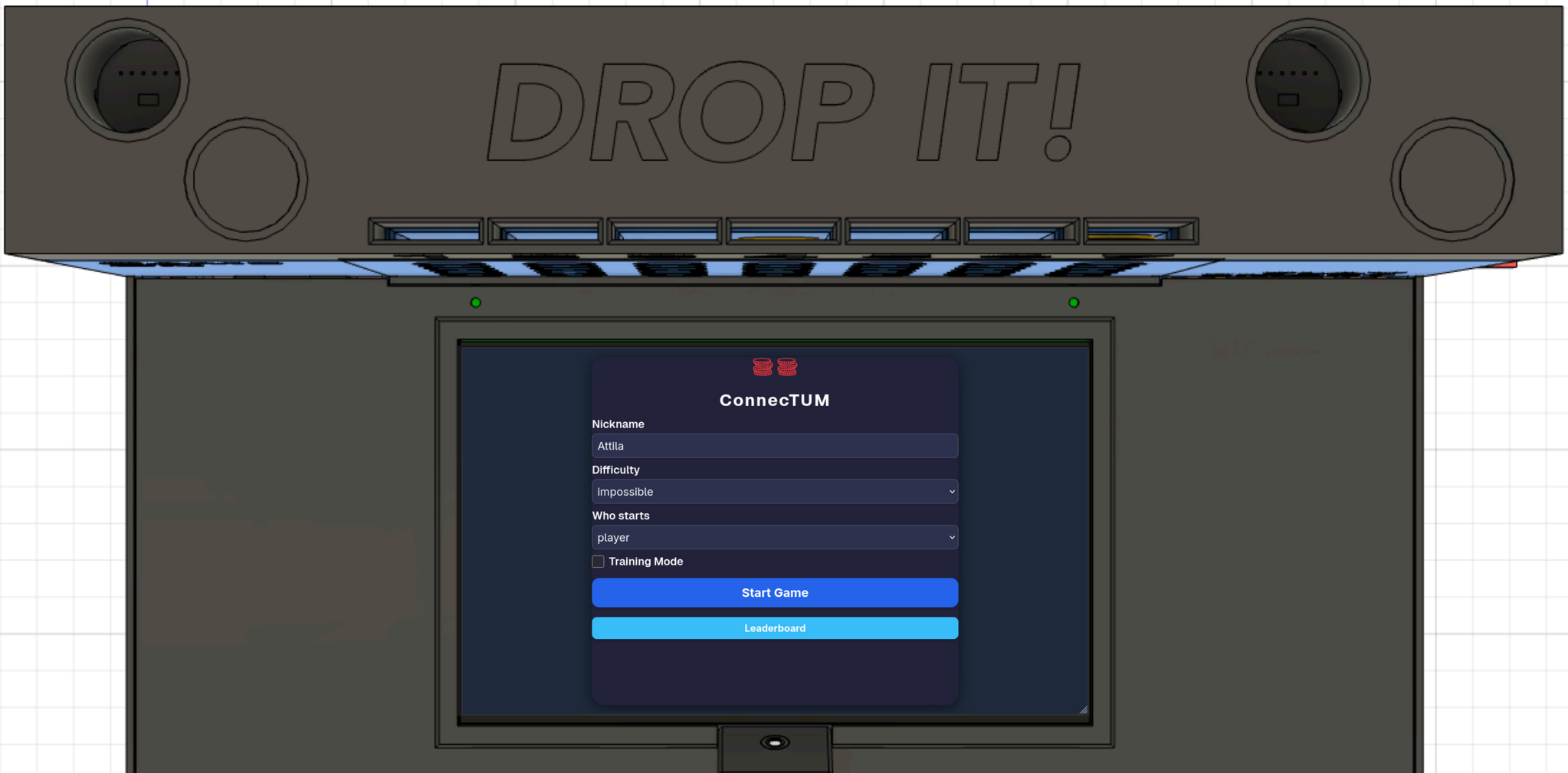


Top Assembly

New Software Development

Software Development

Graphical User Interface



Software Development

Graphical User Interface

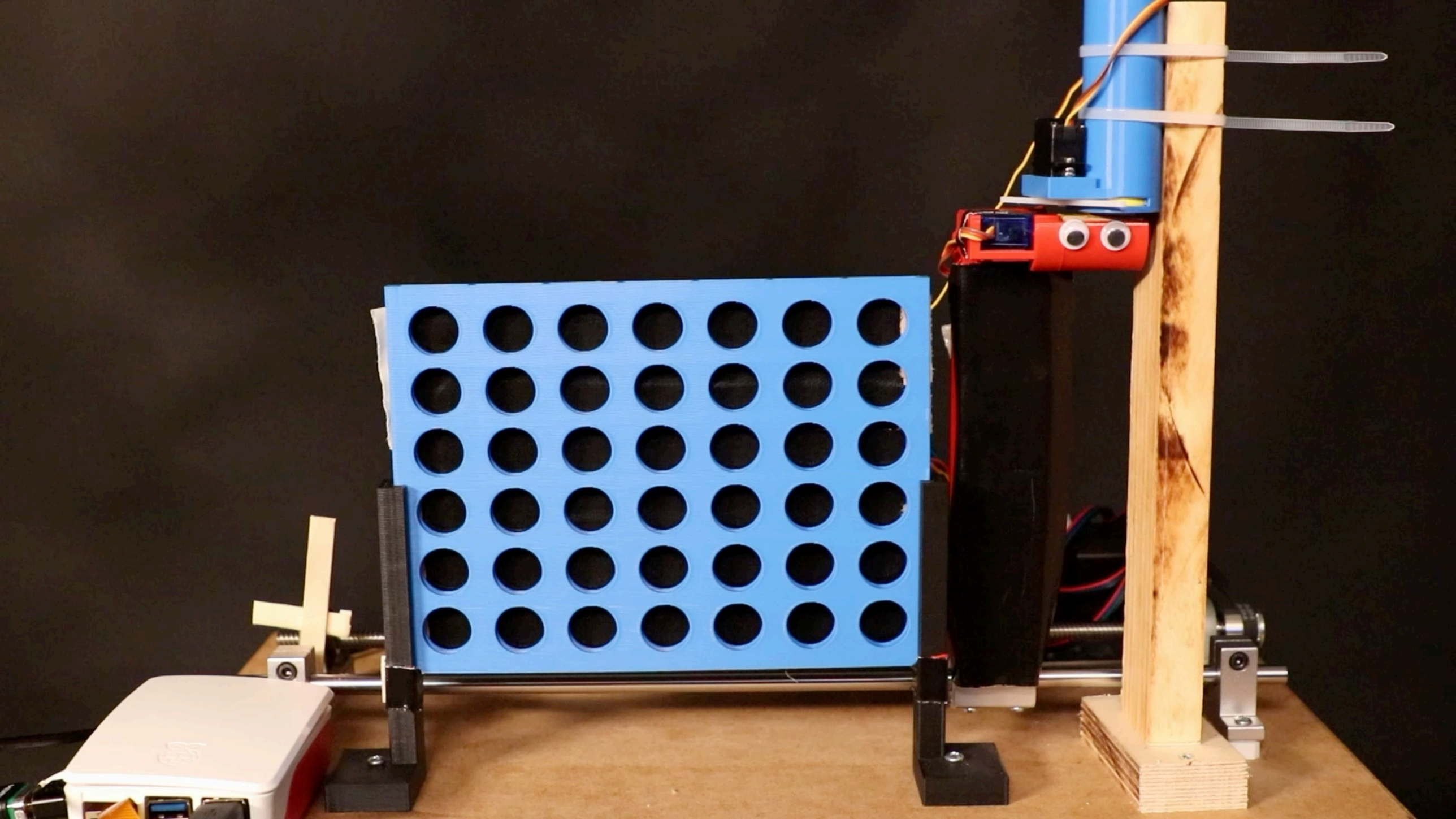
Software Development

Graphical User Interface

Final Thoughts

What we learned

- Need for Sensor Calibration
- System Reliability
- Robust Error Handling
- Advantage of Distributed Systems



CONNECTUM

Project Presentation

22 July 2025 @ Etzelstraße 38, TUM Campus Heilbronn