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LNX ROBOTS

Bratislava, Slovakia

RoboCup Junior Soccer Open 2025

Abstract

We are LNX Robots, a team of four high school students from Gymnázium Grösslingová 18 in Bratislava, Slovakia, participating in the RoboCup Junior Soccer Open category. Last year, we were grateful to achieve second place in World Championship and first place in European Championship, which motivated us to keep improving.
This poster offers a quick look at our robots and the main upgrades we've made since then – especially a **wider dribbler with better grip**, **a more precise, powerful kicker** and an **AI for ball recognition**.
If you have any questions, feel free to ask us in person or contact us on Instagram.

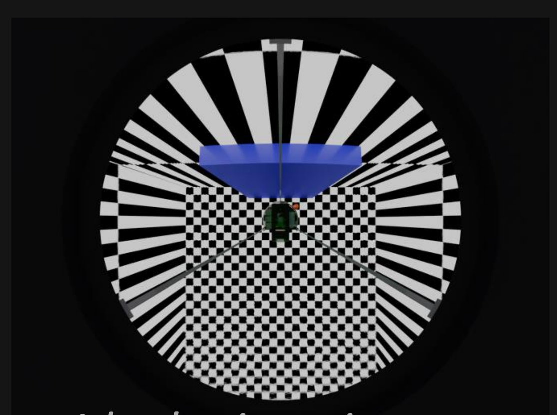
Mechanical Design

All mechanical parts were designed in Autodesk Fusion 360 and initially 3D printed for prototyping. Key components were later replaced with aluminum to improve structural integrity. We selected parts based on our previous experience and online research.

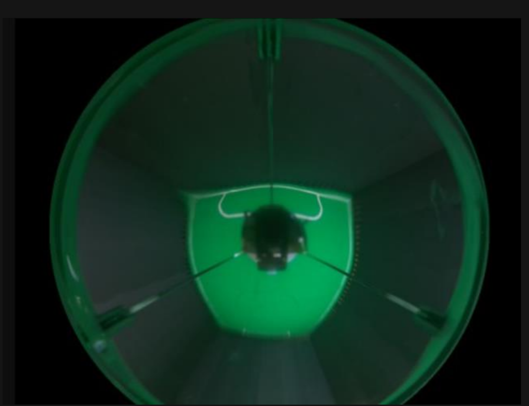
Vision

The mirror shape was computed using a differential equation to make field-plane objects appear equidistant in the virtual image. To test it and optimize camera placement, we simulated the robot and field in Blender. The final mirror was made by vacuum-forming laminated polystyrene.

We also trained a custom YOLOv8 neural network, which runs on a Hailo-8L (13 TOPS) accelerator using the Raspberry Pi AI Kit.



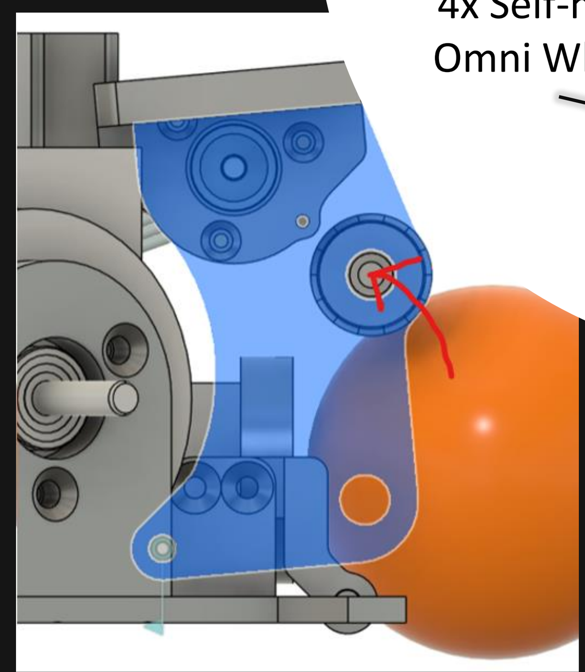
Ideal mirror image



Real mirror image

Dribbler

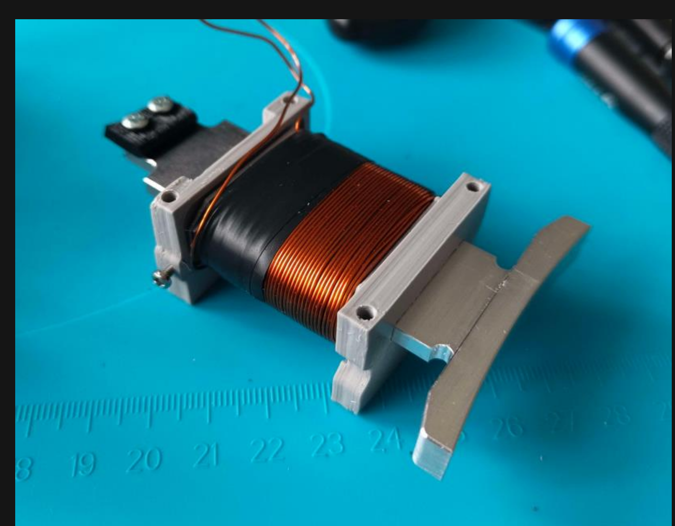
The dribbler is bottom-mounted: rotating around an axle positioned below the ball's top. This configuration significantly improves ball capture and control, as it allows the dribbler to move more naturally with the ball. We've begun testing a smooth bar but haven't yet concluded whether it performs better than the traditional screw-patterned one.



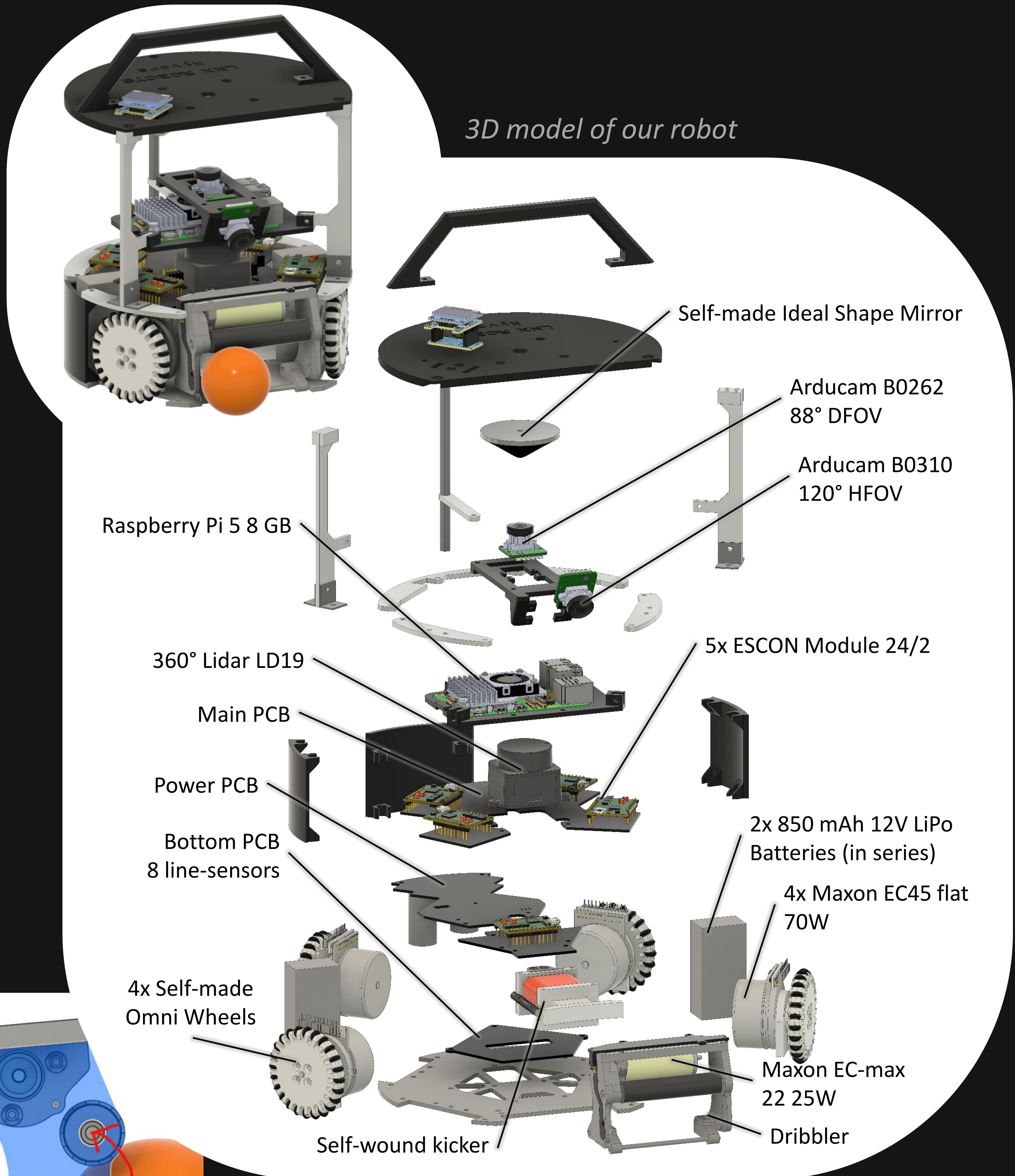
Dribbler from the side

Kicker

To save space, we designed a custom flat solenoid. Its core has a similar mass to the ball to reduce energy loss on impact. We prioritized higher current over more windings for a compact, powerful design. Each 10 ms kick draws 20 A from large capacitors (4.4 mF). Increasing the capacitance further showed minimal effect on performance.



Self-wound solenoid



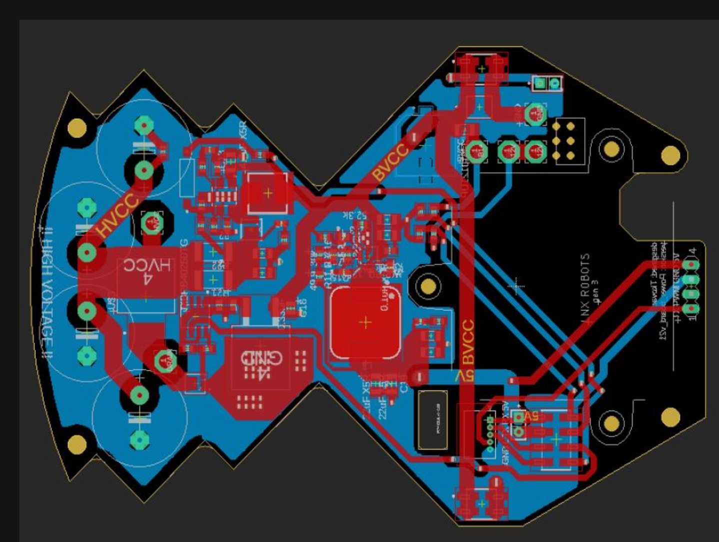
3D model of our robot

Electrical Design

Each robot contains four custom PCBs, designed in Autodesk Eagle. The main processor is a Raspberry Pi 5, which handles camera input and communicates with two STM32 microcontrollers:

- STM32F767: manages UI, gyroscope, motor, and kicker control
- STM32G474: handles line sensors and LiDAR data

All drive motors are direct-drive brushless with encoders, controlled via Escon 24/2 units for fast and precise movement.



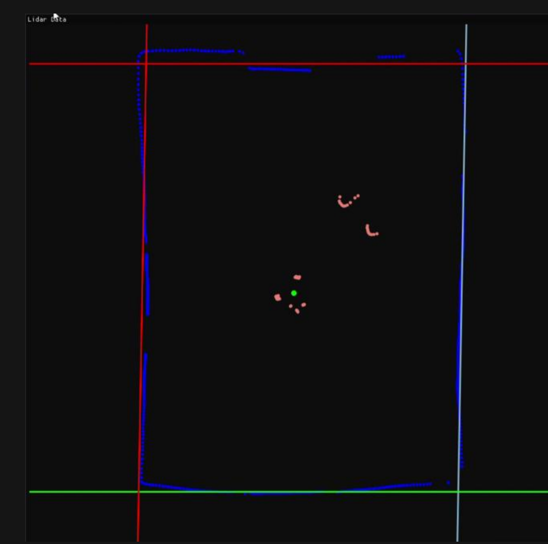
PCB design for power STM

Software

The Raspberry Pi code is written in Python using Visual Studio Code. The STM32 microcontrollers run FreeRTOS and are programmed in C using STM32CubeIDE. We use multithreading to optimize performance, enabling the system to handle image processing from both cameras in parallel.

Positioning

The robot uses a 360° LiDAR to scan its surroundings and identify straight segments in the point cloud that correspond to field walls. It then estimates its position based on their distances and orientations, achieving sub-5 cm accuracy on the field.



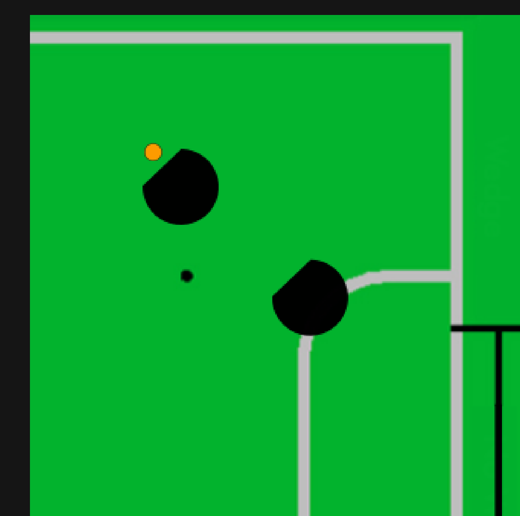
Point cloud of the lidar

Strategy

Knowing our position on the field at all times allows us to adapt our behavior based on where we are.

Goalie

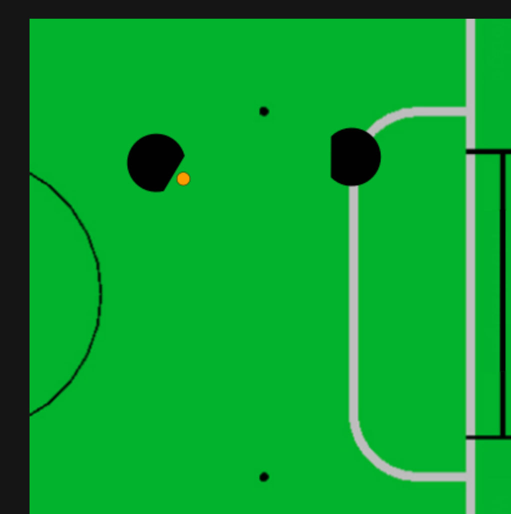
The goalie moves along the penalty area line to block incoming shots. When it gains control of the ball, it performs a kickoff. If an opponent hides the ball, we track their robot's position with LiDAR and defend that position instead.



Goalie's robot defense

Striker

The striker usually plays with a fixed "north-oriented" strategy for better defense but rotates toward the ball when it's near the sides. After gaining control, it shoots toward the largest visible gap in the goal.



Striker's best place to shoot

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