EMM-SOCCER

ESCOLA DOS MORADORES DE MACAU

REGION

MACAU, CHINA

LEAGUE

Soccer Open

Team members

LEI PUI WA — Hardware
YE CHON KIT — Software
SIT IONG / LAO SENG — Electricity

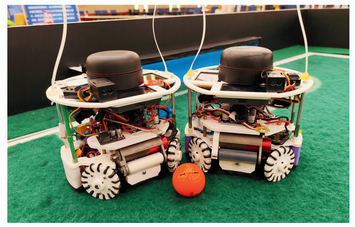
Others

Youtube channel:
https://youtube.com/@emm-soccer

GitHub:
https://github.com/leiemm/emm2025

ABSTRACT

We are a Macau team participating in soccer open. Our team this year consists of three high school students. This year, we have made major changes to our bodies. We hope to play exciting games on the field, communicate with other players, and make progress together.



DESIGN / ALGORITHMS / DATA

Omnidirectional positioning system

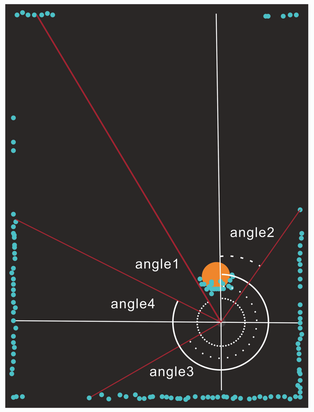
-Use and development of lidar

Although positioning can also be done using traditional one-way lasers, we decided to use lidar for positioning. Because regardless of the robot's angle, it can return data in the exact direction, which diversifies our attack and defense methods.

In addition to this, we don't just use lidar to return distance in a fixed direction, because lidar can perform a full range of range readings, we want to make use of these other orientation data.

So we developed an anti-interference algorithm, that is, even if the front, rear, left, and right are blocked, we can still use data from other directions to estimate the approximate coordinates of the robot on the court.

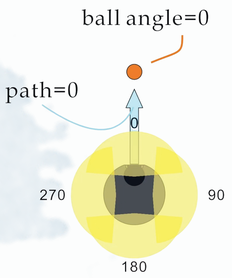
It mainly uses the search for maximum values and trigonometric functions in different directions of lidar, as well as some processing related to angle restrictions, etc. This has greatly developed the role of lidar on the court, but our algorithm still has room for improvement, and we are still optimizing it.



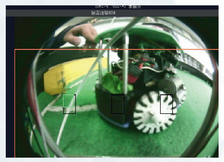
Long-distance vision system

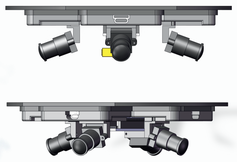
-Use of 4 cameras

Although the traditional omnidirectional mirror can also track the ball, and it is relatively simple, we found in our tests that the camera can find the ball at a long distance by looking directly at the field. So we tested the actual FOV angle of the camera and used 4 cameras to ensure that the camera unit can cover every corner around the robot. This greatly improved our robot's ability to capture the ball.

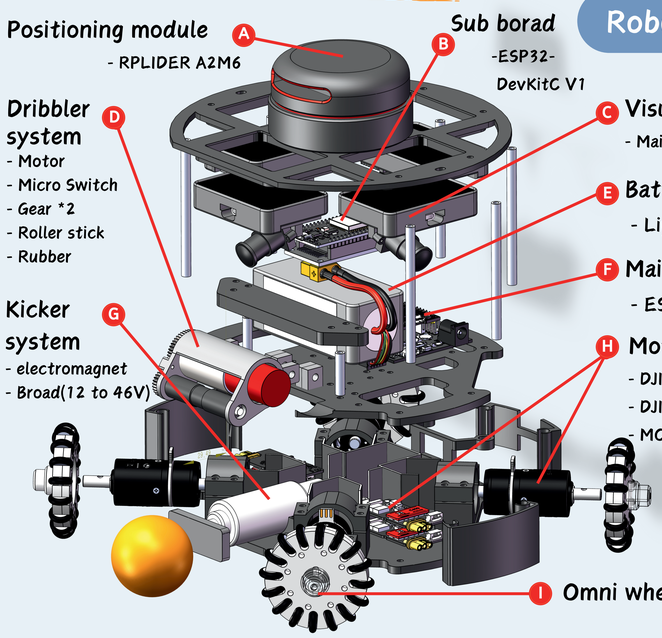


We also tried to use cameras to detect the opponent's robots. The general principle is to find out whether there are color blocks that are not balls within the green court, but this has not been officially put into use in the game.





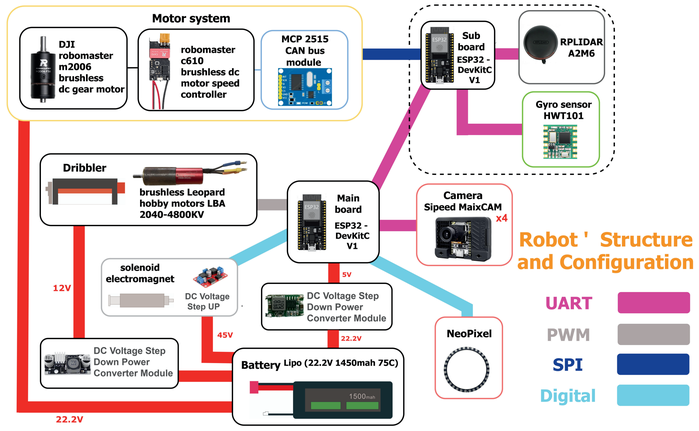
OVERALL



GitHub resources

Robot's Structure

Our robot design was completed in SOLIDWORKS. The main body was 3D printed with high-strength petg filament, and the PCB version was used for circuit optimization. It was designed in JLC EDA. We designed 4 cameras this year and used lidar for ranging, which allows us to have good court data and better ball information, as well as diversified offensive and defensive postures.

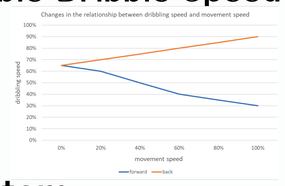


Robot ' Structure and Configuration

Dribble Control System

-Use of Variable Dribble Speed

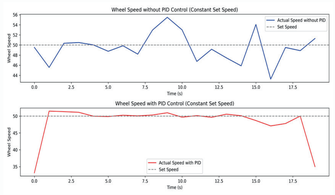
We tested the dribbling ability of the ball dribbler and found that different moving directions also have their own appropriate speeds, so we conducted relevant experiments and decided to use variable dribbling speed control.



Movement speed control system

-Use of PID adjustment

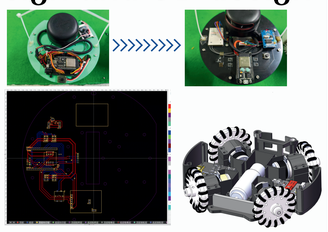
The movement speed of our robot is output after PID calculation, including the angular speed and linear speed of the robot. By setting appropriate kp, ki, and kd, our robot can avoid interference (noise) caused by ground materials to a greater extent, and can also circle the ball more smoothly.



Manufacturing process and safety

-PCB circuit optimization design and 3D design

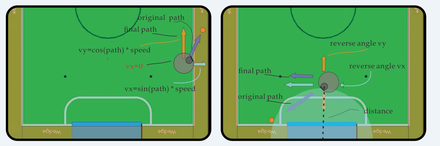
In order to make the circuit wiring more concise, we designed a PCB base plate on the top of the robot, connected to the sub broad, to process the data of the upper structure (radar, gyroscope, camera, etc.). At the same time, our chassis adopts a separated design to make the wiring simple and safe.



STRATEGY

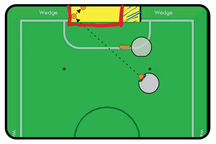
(The video can be found on our YouTube channel.)

Out of bounds

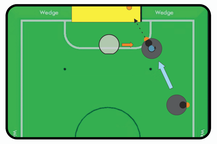


When the robot touches our restricted area (sideline and restricted area), we decompose the speed into the x-axis and y-axis components, then cancel the out-of-bounds direction and re-synthesize to get the final speed.

Offense

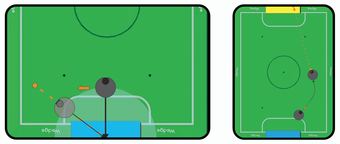


After holding the ball, detect the gap in the goal and quickly shoot the ball to the goal.



Dribble along the sideline, approach the penalty area with your back to the opponent's goalkeeper, then turn around and shoot the goal.

Deffense



Establish a circle as a defensive movement trajectory, and stay on the line connecting the ball and the center of the goal, limiting the opponent's maximum offensive space, with the head always facing outward.When the ball is stationary, it will dribble and then shoot the ball towards the goal.

Environment

SOLIDWORKS · 嘉立创EDA · OpenMV · MaixVision · Bambu Lab · Bambu Lab X1C · J@LC · YouTube · bilibili · GitHub