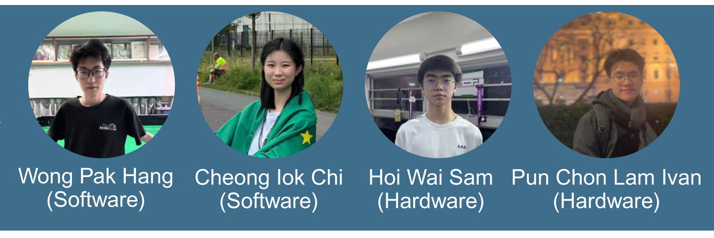
UGAMM-SOCCER
ESCOLA DOS MORADORES DE MACAU

Region MACAU | **League** SOCCER LWL | **Team Member**



About us

We are a team from Escola dos Moradores de Macau participating in the Robocup Junior Soccer. We had an excellent run in the Lightweight Division and were individual runners-up in 2024. Following a change in membership, our team now consists of four students.

Contact
www.youtube.com/@emmrcjlight

Abstract

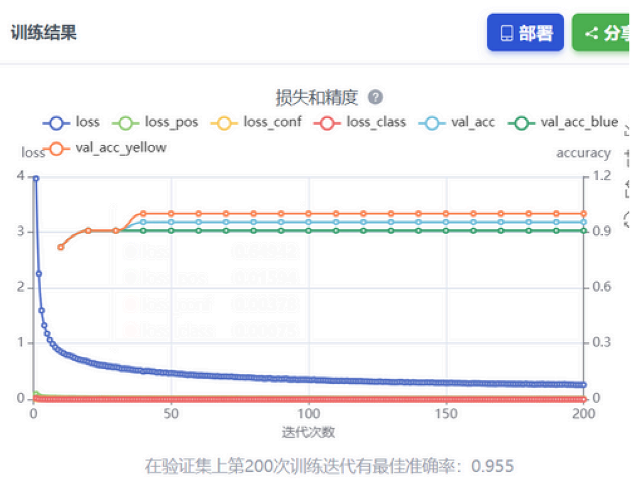
UGAMM SOCCER is a Macanese team participating in Soccer LWL. The team consists of four high school students. For robot design, we mainly use Solidworks. By 3D printers and CNC milling machines, we efficiently created our robots. Additionally, the programming is primarily done in C+/ for most microcontrollers and in MaixVision for the camera.

In preparation for the world tournament, we made modifications to our robots to addressvarious issues identified in the China Open 2025. One significant problem was the chasing the ball is too slow. That's why we've added camera to this World Series. Our cameras not only utilize coordinate positioning based on the front and back range of the camera, but they can also detect gantries, identify their teammates, and predict where the infrared ball is going. That's the new technology we'll be using at Worlds this year.

Although this is our second time participating in the World Championships, we are strongly motivated by "interacting with different people, acquiring different knowledge, and gaining valuable experience." We want to interact with others, learn new things, and gain experience. To share our knowledge with more people, we have created a website and social media accounts.

camera

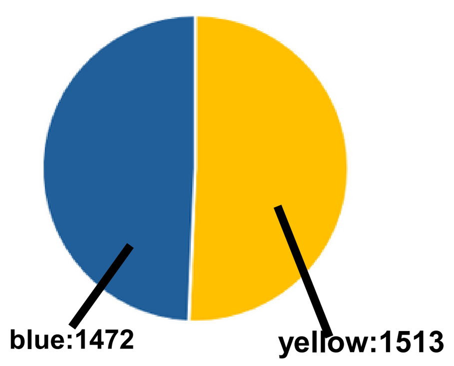
Maixcam's AI model training: MaixHub

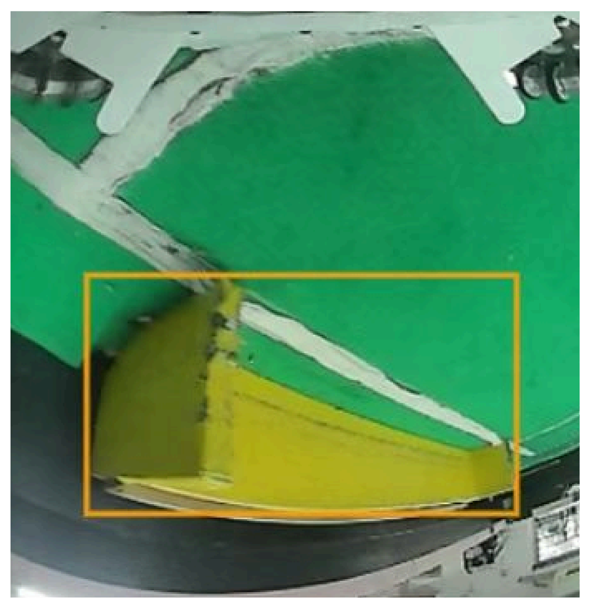


Training result: best accuracy of 0.955

MaixHub is an online training platform designed specifically for AI developers, offering efficient and convenient model training and deployment. Based on powerful deep learning frameworks such as TensorFlow and PyTorch, it provides comprehensive services from data annotation and model training to model optimisation, making it particularly suitable for AI application development on edge computing devices such as the K210 chip.

We imported 1,513 photos of yellow gates and 1,472 photos of blue gates. AI training on the maixhub platform helped us lock down the gates with maixcam, a technique we use in Super Team's defense machine. The Open MV we used last year was easily affected by other off-field colors. Using the AI training module to train the gantry recognition technique allows us to lock the gantry more accurately.





After the training of AI module, the camera can recognize the goal automatically when it sees it, as shown in the left picture. This is a great help to our defense machine program in the boundary defense ball, we can also through the camera to the goal of the （X，Y） coordinates and distance, which will help us segment the program more detailed defense strategy!

Robot Design

The conceptual framework underpinning the ATTACK robot is predicated on the design parameters of a robot with a low centre of gravity and high maintenance requirements. performance". In the context of a robot capable of unrestricted movement within a court environment at elevated velocities, the robot's centre of mass is of minimal significance. It is imperative to consider the role of gravity in this context. The robot's low centre of gravity facilitates the execution of turns and acceleration. The alterations have been executed with minimal force, thereby reducing power consumption and enabling more precise movements. However, achieving a low centre of gravity often necessitates the design of the robot to be compact. The object is densely packed with components internally, which has the potential to compromise maintenance accessibility.

5 compass

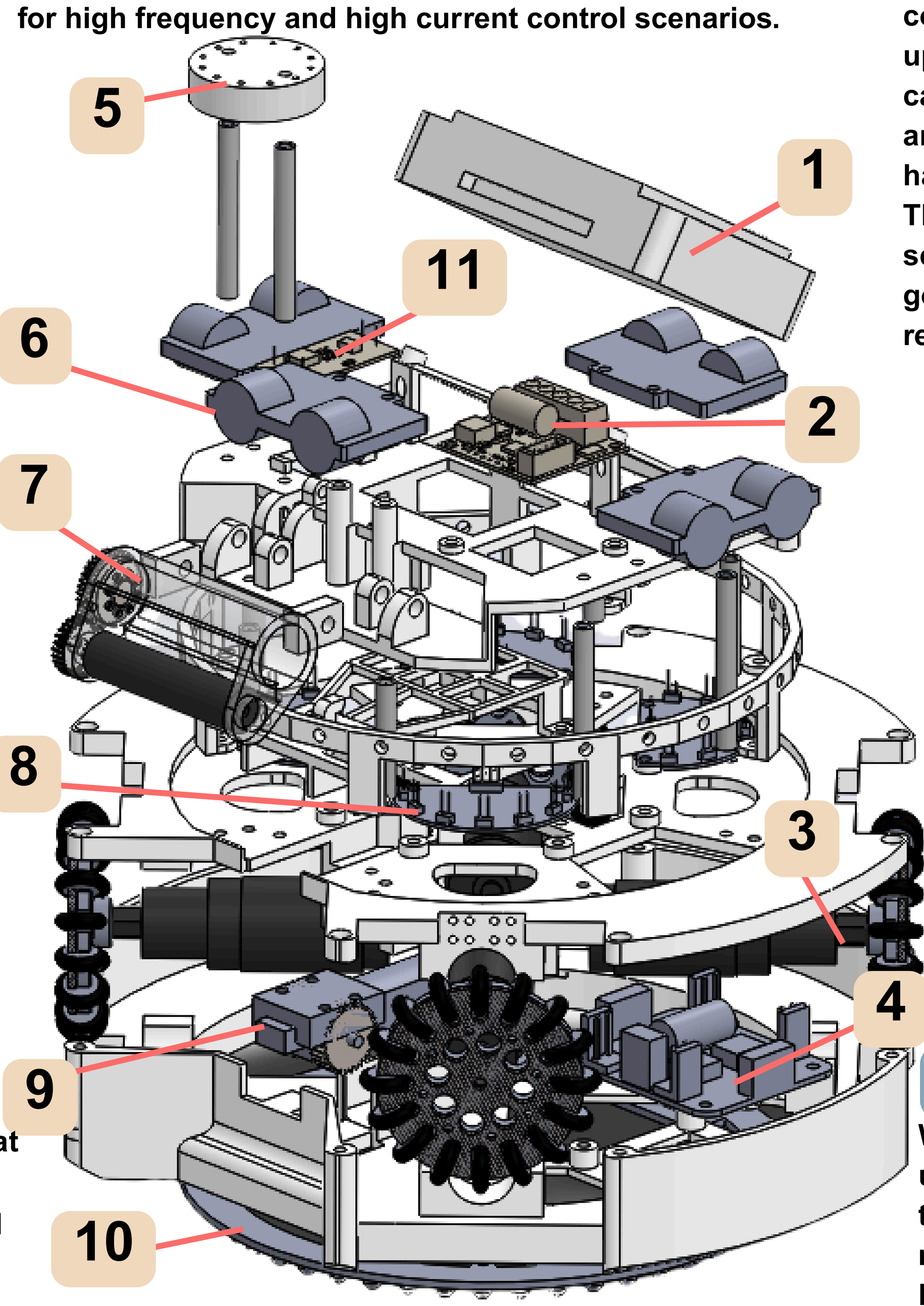
The Zhongming Compass is a high-precision electronic compass module commonly used for robot navigation and positioning. Using a magnetic resistance sensor, it can detect the azimuth angle (0° to 360°) in real time and provide stable, reliable heading data. Supporting both I²C and UART communication, it is compatible with popular controllers such as STM32 and Arduino. Its automatic calibration function and strong anti-electromagnetic interference capabilities make it ideal for educational robots, intelligent vehicles, and competition projects. Its small, compact design and ease of installation make it the ideal sensor for direction control and path planning.

11 Isolated MOSFET module

Isolated MOSFET module is a high performance solid-state switching solution designed to replace traditional mechanical relays. The module adopts opto-coupler isolated driver + high power MOSFET architecture, suitable for high frequency and high current control scenarios.

1 Main Controller

Designed using the STM32F407 series chips of STMicroelectronics' new generation M4 core, it has rich interfaces, compact size, strong performance and extremely low power consumption. The controller runs at a speed of up to 168MHz, has a maximum processing capacity of up to 210DMIPS, and integrates DSP and FPU (Floating Point Unit), which can easily handle various complex computing applications. The newly upgraded 2.4-inch high-definition touch screen and 16MB large capacity memory bring a good operating experience and can fully meet the requirements of various competitions



6 ultrasonic sensor

Zhongming ultrasonic sensor adopts high-frequency acoustic wave ranging principle, the detection range is usually 3cm~400cm, high precision and fast response. With strong anti-interference ability and good stability, it is suitable for robot obstacle avoidance, distance measurement and automatic navigation. Support digital or analog signal output, compatible with mainstream controllers (such as Arduino, STM32).

2 Driver Board

The driver board is designed for three-phase brushless DC motor (BLDC), integrated Hall sensor interface, through the feedback signal to achieve accurate phase change control. It supports PWM speed regulation, with over-current, over-voltage and over-heat protection, and is compatible with 12V-48V wide voltage input. Adopt MOSFET high-efficiency driver, low heat generation, high reliability, suitable for robotics, drones, power tools and other scenarios. On-board signal indicator and debugging interface for easy installation and maintenance, ideal drive solution for automation equipment.

7 Dribbler

The rollers of the disk device are made of silicone. We tested many materials and found that silicone offers the greatest friction coefficient. The fixing parts of the disk device are 3D-printed for lightweight and easy modification. The upper part of the disk device is fixed with torsion springs.

3 Motor

We use four motors to drive the handmade universal wheel, so that the robot can carry out the front and back of the left and right movement, rotation, panning and other actions. Motors are made by Faulhaber (12v 750rpm)

4 Sub board

It can convert digital signals into motor control signals, thus facilitating motor control. Despite its compact size and lightweight design, it is limited to controlling only two motors simultaneously. It can only control two motors simultaneously.

8 Compound Eye

Zhongming Composite Eye is a high-performance multi-channel infrared optoelectronic sensor module. The sensor adopts array type infrared transmitting and receiving unit, which can simultaneously detect the distance of obstacles or ground patrol signals in multiple directions, realizing omni-directional environment scanning. High sensitivity and strong anti-interference ability, effectively filtering out the interference of ambient light to ensure stable and reliable detection data. The module supports dual output modes of digital signal (switch) and analog signal (distance intensity), and is compatible with STM32, Arduino and other mainstream controllers, which is convenient for secondary development and system integration.

9 kicker

The Kicker we are using is a homemade, 3D printed puller, push tabs As well as homemade slides. And 12V16 worm gear reducer is designed for industrial use and has a high reduction ratio of 1030:1. It is designed for heavy-duty equipment and high-torque applications. The core transmission system consists of a high-strength alloy steel worm (surface hardness HRC58-62) and a special bronze worm wheel (CuSn12Ni), which are precisely meshed and undergo CNC grinding to achieve a transmission accuracy of DIN 6.

10 Line Sensor

The Line Sensor board PCB features a ring-shaped design. The power supply is divided into 3.3V for LEDs and 5V for line sensors, effectively reducing heat generation. Additionally, aligning the pin headers with the main substrate facilitated a neat and organized wiring layout

Vision System

Four eyes to find the ball

In the past, we used two compound eyes to detect the position of the infrared sphere, but we could not detect the position at a distance. Therefore, we use four compound eyes to detect the position of the infrared sphere more accurately this time.

Our defense machine uses Maixcam to detect the position of the ball, so we can know the position of the ball more accurately and we have a better defense effect. It also improves the situation of not being able to defend the ball on the field of superteam in the past, so that we can defend the ball more quickly.

Environment

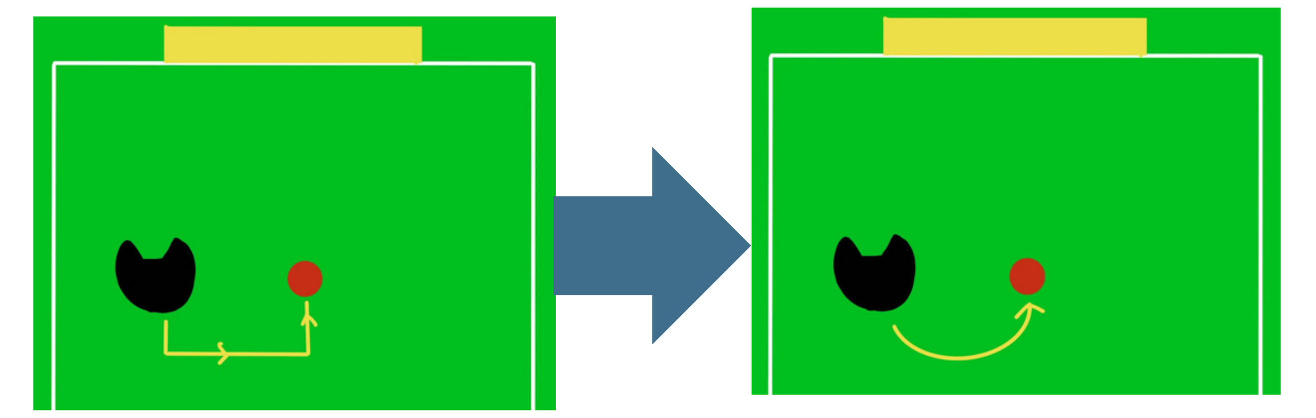
Communication | **Hardware** | **Software**

Bambu Lab

CorelDRAW

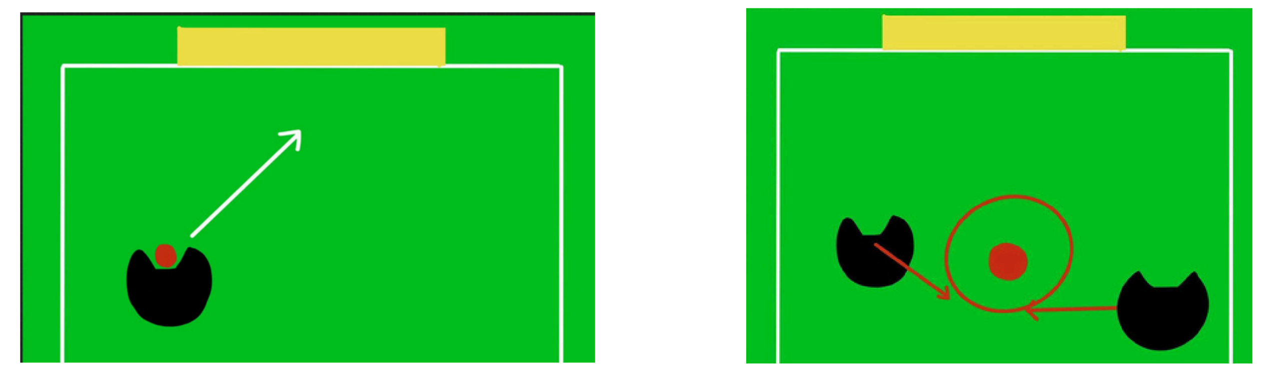
Strategy

For balls behind the robot



When the ball is situated behind the robot, our initial strategy involved the robot's movement to the location specified. The objective is to locate the backside of the ball and pursue it. However, this methodology adopted in this study was time-consuming, and the robot was utilised in the process. It was necessary for the subject to progress in a linear fashion. The objective is to optimise the process. The following methodology was employed: an algorithm was implemented. The robot's objective is to pursue the ball along a curved trajectory.

Balls in frontand Wraparound



Flanking is performed using the tangent of a circle. If the distance is great, create a circle of any size centred on the ball, Proceed towards its tangent. If the distance is short, flank at a 90-degree angle. Once you are in front of the ball, move forward towards the goal. This method improves code readability and allows for efficient and accurate shortest distance flanking by simply changing the radius of the circle. This makes adjustments easier.

Compound eye weighting

1. Number the 28 compound eyes (A0~A27) with 0 being directly in front of them.
2. Sum the light values of the 28 compound eyes (B0~B27) and find the number a of the compound eye with the largest light value.
3. Renumber the compound eyes with a as 0 (example: C0=A0-a).
4. if C ≥ 15 or C ≤ -15, subtract 28 from or add 28 to C to ensure that the range of values from C0 to C27 is
First case:C ∈ [-14~13]
Second case:C ∈ [-13~14]
5. set the light value of the compound eye numbered C as -14 or 14 to 0 to ensure that the number of data on both sides of compound eye a is balanced (13 on each side)
6. multiply each compound eye number with the light value and add the total (C0×B0+C1×B1+... +C27 × B27), and then divided by the summed sum of light values to obtain the deviation value k ∈ (-0.5~0.5) centered on compound eye a
7. take the maximum light value compound eye original number a plus the deviation value k and multiply by the compound eye angle to get the angle of the ball (angle = (a + k) × 360/28)
(angle ∈ [0~360))

System Configuration Diagram