Oi_DENGIKEN

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Japan

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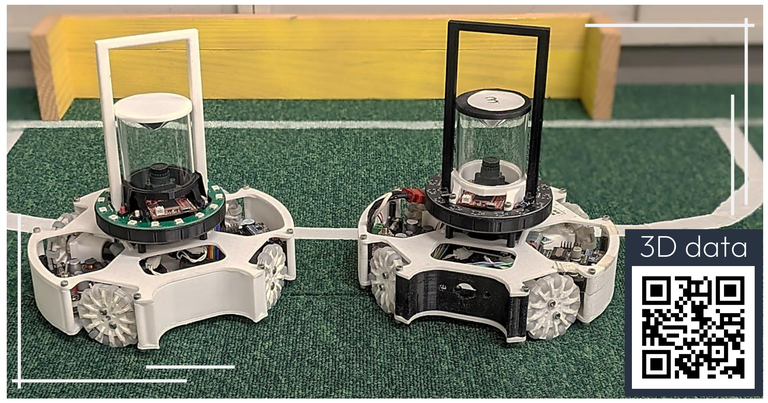
Team HP & QR code
dengiken.jp/oi-dengiken/
(Japanese and English ver)
Belong to
Dengiken Club

Soccer Light Weight League
Supported by

New Innovations

JLCPCB



Abstracts

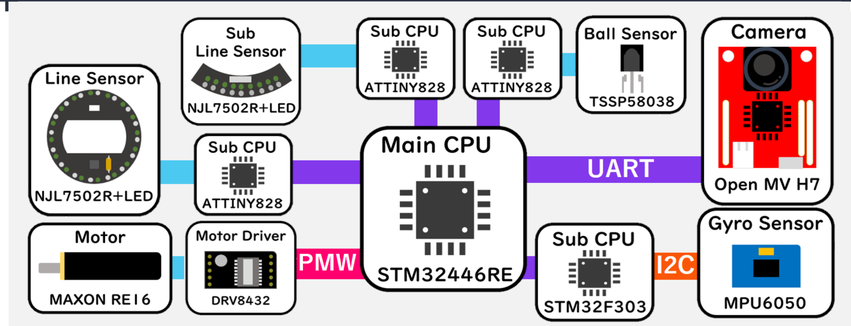
Summary

We are committed to creating robots that operate stably. **To achieve this, we have been working on developing and testing hypotheses repeatedly.** For example, we conducted research on the mirror shape for the omni-directional camera and improved the line sensor to create a robot that stays within bounds. By adding a touch of innovation to a general idea, we have created a unique robot that stands out.

Enthusiasm

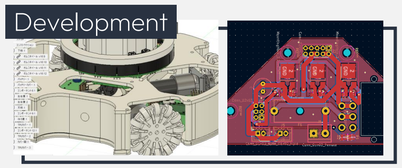
We are participating in the World Championships for the first time. We hope to gain valuable experiences and learnings that can only be obtained here, and we intend to apply them in the future. **Furthermore, to make meaningful interactions with everyone, we have made our created website, videos, and other data available for public access.**

System Rough Sketch



Hardware

Development

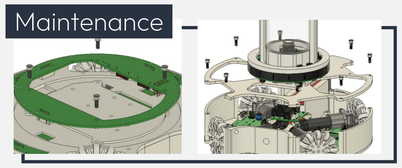


We designed the robot by us using **Fusion360**, and its shape is optimized through multiple iterations using a 3D printer. The Printed circuit board is designed by us using **Kicad**. We ordered the parts from JLCPCB to assemble the robot.

Battery Cover

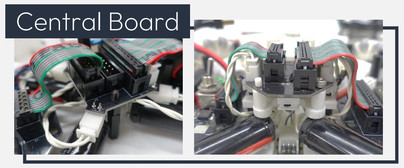
We have created a battery cover for the 3D printer using TPU filament to facilitate quick battery replacement. This cover can be easily removed without the need for any tools. With the use of this cover, we can make more efficient use of halftime.

Maintenance



The robot we have created can access all areas by simply removing one screw and one connector. The line sensor can also be easily detached from the reverse-side of the robot. With a single hex driver, we can disassemble the robot completely.

Central Board

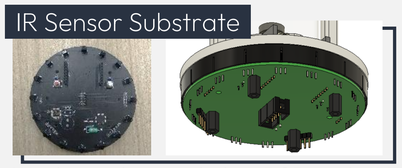


The wiring for the motor, line sensor, infrared sensor, and OpenMV, are combined on a single board. **This board also serves as a relay board, connecting the power board and the main board.** To reduce the number of wires, we used flat cables.

Omni Wheel

To create a robot that could not be pushed around, We cut silicon tubing to make thicker sub wheels. **Additionally, we streaked the surface of the 3D-printed frame to increase its strength.** This wheels has never broken until now.

IR Sensor Substrate

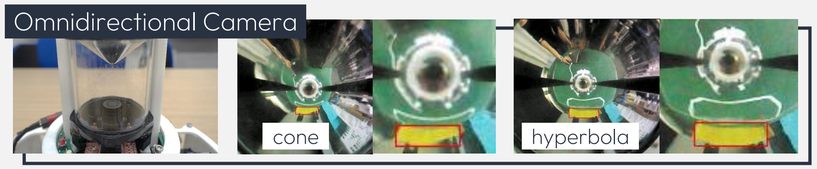


We have designed this PCB with 16 infrared sensors. The board is also equipped with the capability to connect omnidirectional cameras. **The wiring has been consolidated into a single flat cable, which is connected to an central board.**

Line Sensor

The robot we previously created used 16 sensors. However, it had a tendency to deviate from the white line. **To address this issue, we added sensors to the outer edges to enhance its responsiveness.** The circular line sensor and the outer line sensor have different roles, which will be explained in more detail in the (Software) on the right side.

Omnidirectional Camera

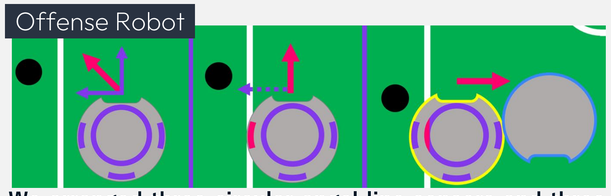


We created omni-directional camera by using a PVC mirror sheet that we heat pressed and formed into a 3D printer mold. We combined the molded mirror, acrylic pipe, 3D printer parts, and OpenMV H7 to create the final product.

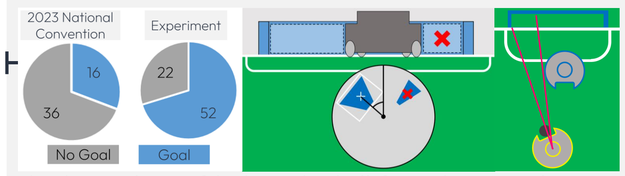
We determined the shape of the mirror by comparing cones and hyperbolas. As part of our design process, we placed the robot 50cm from the goal and captured OpenMV images. **After analyzing the results, we chose the hyperbola as it provides less distortion and more accurate coordinate information.**

Software

Offense Robot



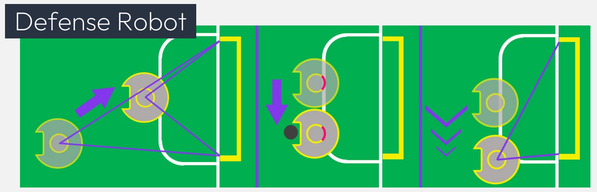
We arranged three circular angel line sensors and three sub-line sensors, each serving different roles, as part of our design. The circular line sensors are responsible for reading the white line and calculating the angle needed for the robot to stay within the court. By incorporating variables that add force to return inward when the robot stays above the white line, we have created a robot that avoids going outside the line. Additionally, when the right sub-line sensor detects the line, the force for the robot to move to the right is set to zero, allowing for smooth movement along the white line. We implemented these functionalities in the development of the robot.



In the analysis of kicking the ball from the neutral point, we compared the results of 7 matches in the 2023 National Tournament with the outcomes of experiments conducted on the court. In the national tournament, our robot scored 16 goals out of 52 attempts, resulting in a success rate of approximately 30.7%. **However, during the experiment, our robot achieved a higher success rate, scoring 52 goals out of 74 attempts, which corresponds to about 70.2%.** These results demonstrate the effectiveness of the strategies and improvements we implemented in our robot to enhance its goal-scoring capabilities.

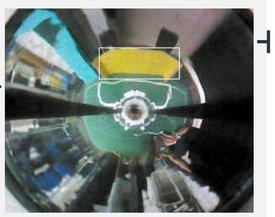
We are using an omni-directional camera to increase the scoring percentage from the neutral point. **We have developed a program that tilts the robot towards the direction with a larger recognized area.** As a result, we are able to avoid the opponent's robot and score goals.

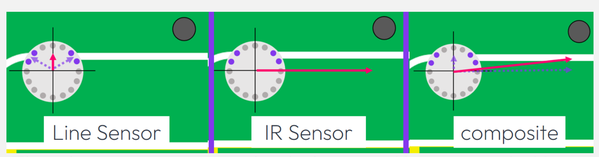
Defense Robot



We have developed a system, utilizes the omnidirectional camera to detect the goal and position itself in front of it. Once it reaches the desired position, the robot follows the white line while tracking the ball through line tracing. If the robot approaches the edge of the penalty area during this process, it automatically slows down to prevent going outside the designated area. **In case the ball is not detected, the robot moves to the center of the goal and remains ready to respond promptly.** We programmed these functionalities and behaviors to enhance the robot's performance and adaptability during gameplay.

With line sensors alone, it is unable to return to the penalty area when moving at high speed or when pushed by another robot. **However, by incorporating the omni-directional camera, we have successfully addressed this limitation and enabled the robot to stay within the penalty area.**





The line sensor is divided into X-axis and Y-axis components as coordinates, and the IR sensor value is also considered as a coordinate. **The movement direction of our robot is determined by compositing the values of the line sensor and the IR sensor.** By integrating the inputs from the line sensor and IR sensor, our robot can move while simultaneously prioritizing ball chasing and staying within the penalty area.