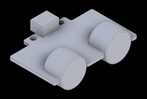
LOVBOT ALTRONS

HARDWARE



Ultrasonics

Tracks the distance from the bot to another object

OpenMV RT1062

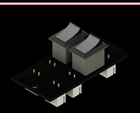
Used for seeing the ball and the goals

Takaha Solenoid (Kicker)

Being able to kick and propel the ball forward with momentum

Wheels

Custom made and tuned for fluid movement



Switch Board

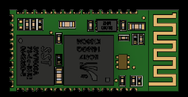
Turns the bot and the motors on and off

JMP DC Motor

Used for movement of the bot

MPU 6050

Maintains the bot's direction for movement



HC-05 Bluetooth Module

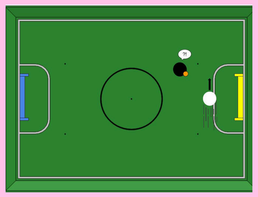
Allows bluetooth communication between the two bots

Teensy 4.1

Main microcontroller and processor

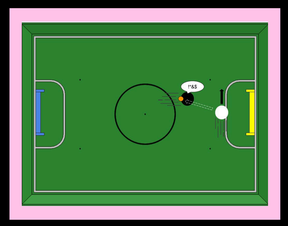
DEFENCE

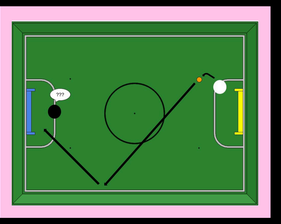
The defending bot is meant to account for every problem that could possibly occur when the offence fails to obtain the ball. This means that it has to be able to block the ball's path from entering the goal at any angle and at any time.



The robot would find the optimal angle that minimizes the opponent's robot to score by calculating the angle in which the ball is approaching meaning it parks at that point and blocks the ball from being able to be aimed at the goal.

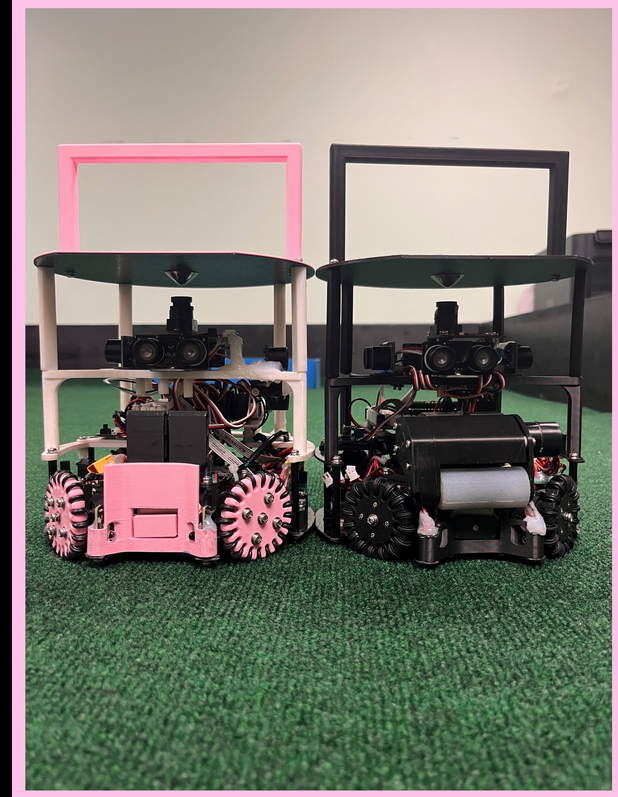
As many offence strategies include hiding the ball from the view of the defending bot, when this situation occurs, we try to predict where the ball will end up. Which means that we try to foresee the path of the ball and then we prepare accordingly.





To avoid lack of progress, the goalie would become offencive for a certain period of time should the ball stall somewhere on the field, ensuring that we do not miss an opportunity to score.

In addition, there are also numerous speed calculations that we use for the defending bot to be able to determine the importance of guarding the ball. The speed varies at all times, depending on the location of the ball, the bot's distance from the ball, and the direction of travel of the ball.



Emma Zhou

- **Defence**
- **Documentation**
- **Gameplay**
- **Strategies**

Felix Hang

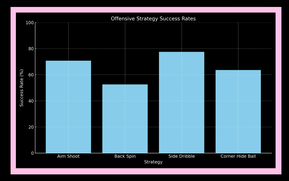
- **Offence**
- **Mechanical design**
- **Electrical design**

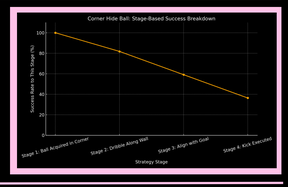
ABSTRACT

Team Altrons consists of one grade 9 student, Emma Zhou, and one grade 10 student, Felix Hang. We are participating in Open League. Our team was formed in September of 2024, and since then we have worked on our robots consistently every week. Since starting our team, we have been working on various software strategies between the defence and the offence bots, including our cooperation strategy, multiple offence hide ball strategies and more consistent saves from the defending bot (more info can be seen on our poster). Furthermore, we have made multiple hardware advancements to account for the strategies we want to perfect; therefore, the offence bot has an improved dribbler that can be utilized when performing hide ball strategies. To summarize, we have been making improvements in all aspects of our robots to achieve a better outcome.

PERFORMANCE EVALUATION

To improve in-game decision-making, we've developed a data logging system that records the performance of each offensive strategy every time it is executed. This includes the strategy name, whether the action was successful, how long it took to complete, and where on the field it began. The robot then analyzes this data over time to estimate which strategies are the most reliable under different conditions. For multi-stage strategies like Corner Hide Ball, the robot logs how far it progresses—such as obtaining the ball, dribbling along the wall, aligning with the goal, and kicking. Each stage is tracked, and success rates are calculated based on how consistently the robot reaches each point.

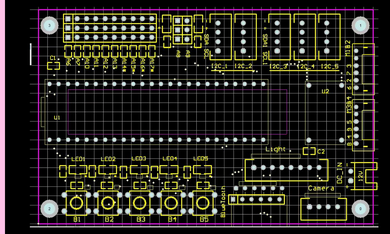




During each run, the robot logs the furthest stage reached before losing possession of the ball. This allows us to see where improvements are needed. The following table demonstrates a preference towards side dribbling and hiding the ball over back spin.

Strategy	Total Runs	Successes	Success Rate (%)	Avg Duration (s)	Start Region
Back Spin	95	50	52.60%	3.5	Center
Side Dribble	80	62	77.50%	6.1	Left Edge
Corner Hide Ball	110	70	63.60%	5.8	Corner

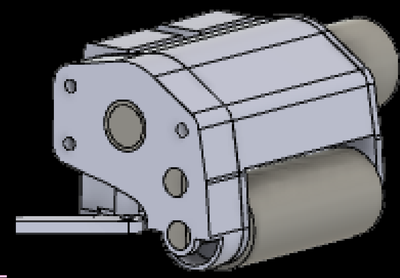
CUSTOM-MADE TEENSY SHIELD



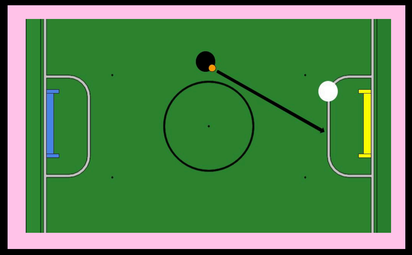
We designed and built a custom PCB shield for the Teensy 4.1 to serve as the main interface on our robot. It features 12 analog input ports for connecting sensors, 5 separate I²C ports to support multiple devices without address conflicts, and two dedicated connections for motor drivers. We also included a UART port for serial communication with our OpenMV camera, as well as 5 buttons and 5 LEDs that we use for debugging and status indication. The board also features a built-in voltage regulator module, which ensures compatibility with the Teensy and other components. This shield helps us keep the wiring organized, simplifies integration, and plays a key role in getting our robot running smoothly and reliably.

DRIBBLER

The dribbler mechanism consists of a high-speed motor coupled to a 3-stage brass gear train with a total reduction ratio of 2:1, optimized to increase rotational speed while maintaining sufficient torque for controlled ball handling. The final output drives a custom-fabricated silicone roller designed with an inward curvature, creating a compliant contact surface that pulls the ball inward upon rotation. The entire assembly is vertically compliant via a tensioned band system, allowing passive vertical displacement to absorb impact forces and maintain consistent pressure on the ball. This configuration prioritizes excessive torque to improve responsiveness and grip during dribbling and trapping maneuvers. Since last year, we have made multiple improvements because we had gear box issues and it was physically fragile and mechanically unsound. From previous years experience, we have enhanced and improved this design to create a more durable and reliable dribbler to use.



OFFENCE

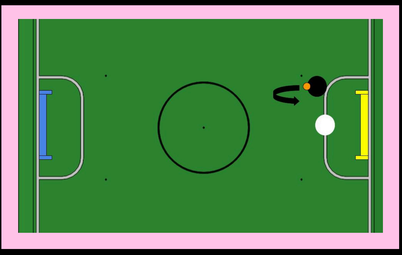


Aim Shoot

Once the offensive robot gains possession of the ball, it immediately scans the opponent's goal for an open area. It then quickly aims itself to that angle and executes a kick to maximize scoring chances.

Side Dribble

When the robot gains possession of the ball near the edge of the field, it dribbles along the sideline toward the opponent's goal. This maneuver helps maintain control while advancing the play from a less congested area.



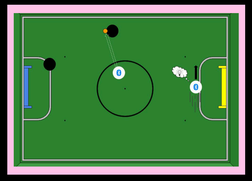
Back Spin (New)

When the robot gains control of the ball near the centre of the field—a typically crowded area—it initiates a slow backward dribble while turning. It then spins at a very high speed to shoot the ball into the goal. This strategy aims to obscure the ball from opponents and launch a surprise attack towards their goal.

Corner Hide Ball

We observed that the ball often gets trapped in the corners of the field. In this strategy, the robot retrieves the ball from the corner, conceals it to avoid detection, and quickly dribbles it toward the goal—all before a "lack of progress" call can be triggered. Successfully escaping the corner, significantly boosts our scoring chances.

COOPERATION STRATEGIES



Since we play with a passive orange ball, only tracked by the camera, the ball may often disappear from the robot's vision which is caused by another object being in front of it. As soon as both robots fail to locate the ball, we would immediately begin to search for the ball across the field, in case an opponent robot is attempting to perform strategies that involve hiding the ball. The robots will also share ball information with one another should one of them see the ball and the other one doesn't. The offense robot will be mainly in charge of the front section of the field, leaving the back half for the goalie to avoid them fighting one another for the ball and the possibility of double defense.

This table showcases cooperative strategies we've developed between our offense and defense robots to improve team performance during matches. Each strategy is designed based on real gameplay observations, such as losing visual on the ball or avoiding both robots chasing the same target. By dynamically sharing responsibilities, field zones, and ball information, our robots can cover more ground, react faster, and make smarter plays together. Whether it's scanning for a hidden ball or setting up a delayed shot using input from the other robot, these strategies help us stay efficient and adaptable throughout the game.

Strategy Name	Trigger Condition	Cooperation Mechanism	Purpose / Outcome
Ball Lost Protocol	Neither robot sees the ball	Both start scanning different field zones; share angle & confidence level if found	Minimize time searching for hidden/blocked ball
Zone Splitting	Normal play	Field split into front/back; offense stays forward, defense stays back	Avoid redundant movement; optimize field coverage
Goal Zone Defense	Ball near defensive zone but offense bot is closer	Offense bot temporarily takes defensive role while goalie repositions	Prevent double commits; maximize closest robot response
Ball Handoff	Ball near midfield and seen by defense bot	Defense moves ball toward center and passes off to offense bot	Fast transition from defense to offense
Delayed Kick Setup	Offense bot has ball but can't find open goal	Defense bot communicates angle of open goal from its perspective	Faster goal alignment; uses dual perspectives to find scoring window