Closed Challenge – Autonomous Vehicle Challenge

Background:

Over the last century, robotics made huge strides by excelling in controlled environments such as factory floors. However, today's world demands more dynamic and adaptive machines that can operate amid uncertainty—varying surfaces, shifting obstacles, and unexpected interactions with other moving things. To tackle real-world challenges, robots must now detect, decide, and act on the fly in ever-changing conditions.

Challenge Description:

In this year's closed challenge, participants will dive into the realm of autonomous robotics using their Arduino-based kits and only the supplemental materials provided in the hardware kit. Teams must design a robot that can interpret color-coded floor markers and use its sensors to accomplish three challenge courses. Below are the three challenge courses:

Challenge courses:

1. Color detection and place the flag
    - In this challenge, participants will program their robots to navigate through a series of six concentric rings, each with RGB colors and no three consecutive rings will have the same color. The goal is to detect the colors, adjust the robot's path, and successfully navigate toward the center of the rings and drop the flag off. The robot will start facing away from the center and holding the flag, requiring teams to utilize color detection and pathfinding algorithms to reach the target. Points are awarded based on how close the robot gets to the center—the closer to the center, the higher the score!

2. Maze Navigation
    - In this challenge, hackers are encouraged to develop more advanced algorithms, thus succeeding in both speed and quality. The maze diagram of Challenge #2 below shows that two key components in the maze are the walls and coloured tiles. Each tile will correspond to an action the robot has to perform and the robot must navigate through all the orange points. **Only follow the instruction of the color when the robot meets the wall or boundary, go straight otherwise.** Please check the example for details.

3. Color Pattern detection
    - Your robot will navigate through a maze scattered with randomly placed colored tiles. You will be given a sequence of colors that the robot must detect in the correct order as it travels. Each time the robot detects a color from the sequence, it should blink its LED. If the sequence contains the same color twice in a row, the robot must visit two different tiles of that color before moving on. Walls and obstacles will be present in the maze, the robot must steer around them.
    - The color sequence is as shown, need to be followed by all the hackers:

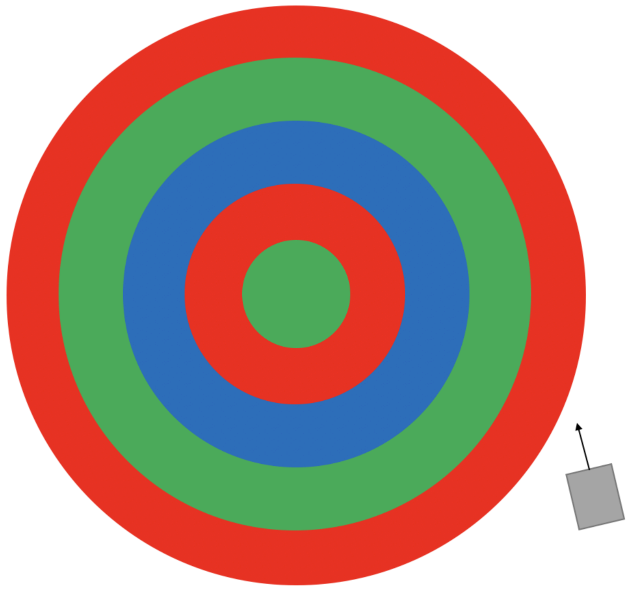
      Red -> Greens -> Blue -> Green -> Blue

- The **last two colors (Second Green & Blue) detected cannot be the same block detected as before**.
    - This means, we know the 2nd and 4th colors need to be green, if your robot has already passed a green block for the 2nd color, the green color for the 4th cannot be this same red block anymore. It needs to search for the green that has not been touched before.
    - Same for the 5th blue.
- In both part 2 and 3, be careful of the wall collision, which will reduce the scores.

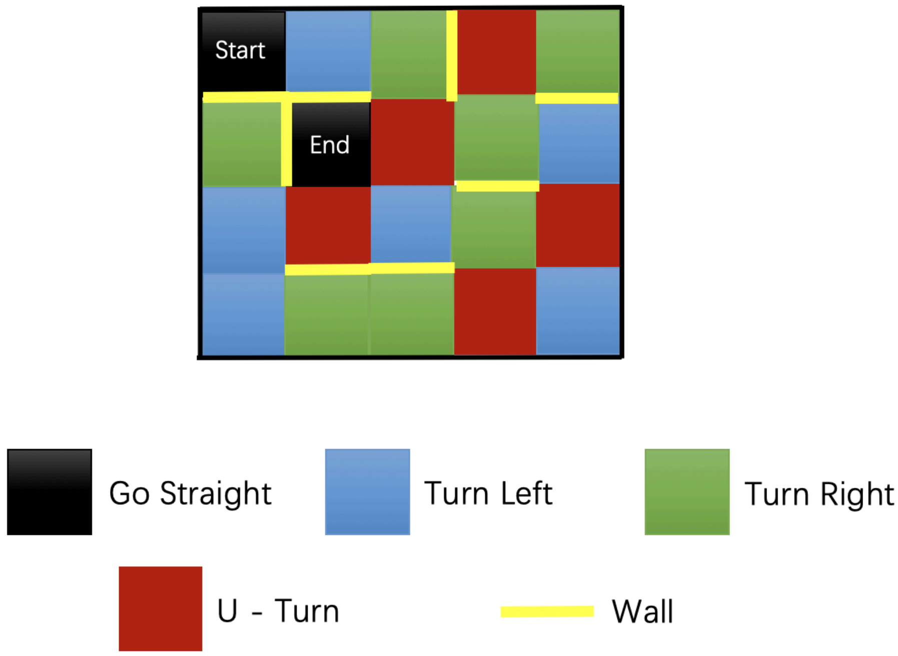
Challenge Map Examples

Examples for practice, the final testing courses will be different.

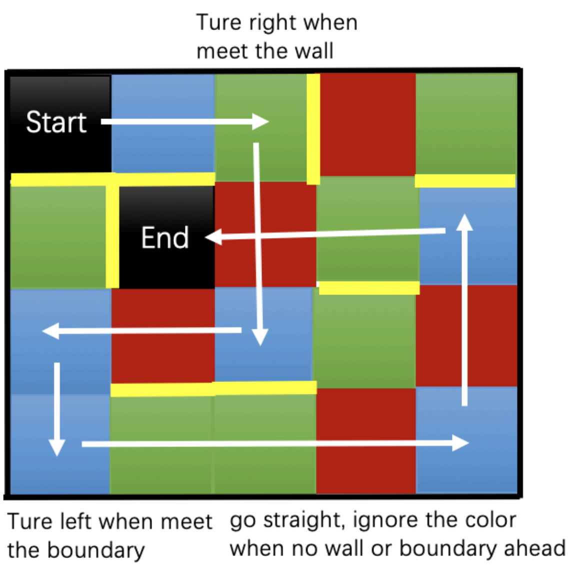
1. Color detection and place the flag



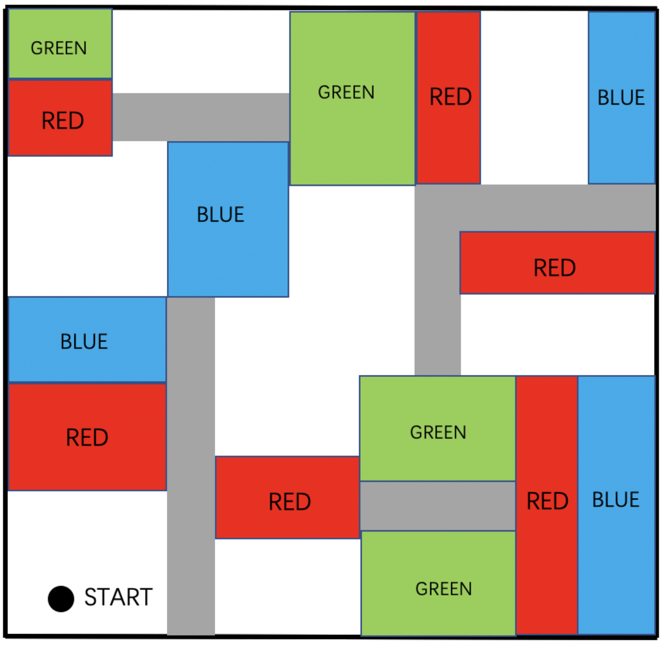
2. Maze Navigation



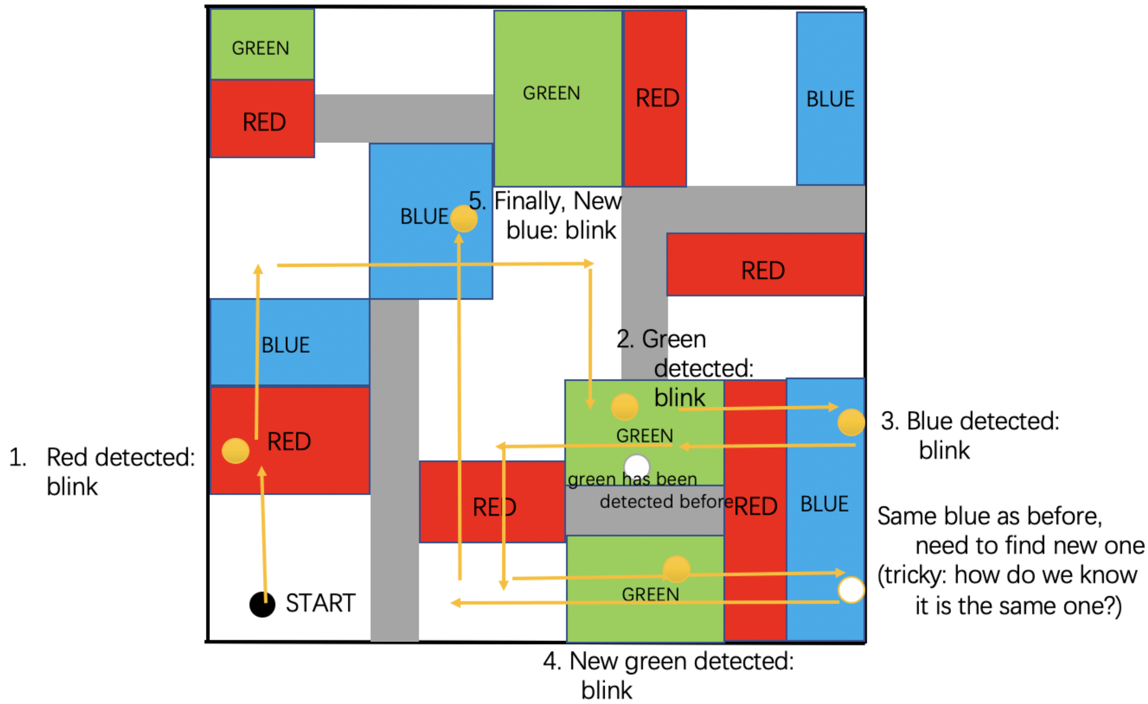
the correct nav path if follow the instruction currently:



3. Color Pattern detection



one example of the correct nav path in part 3:



Open Design Challenge - Guidelines

Background

The Global Goals, also known as the Sustainable Development Goals (SDGs), are a set of 17 interconnected objectives adopted by the United Nations to create a better and more sustainable future by 2030. Goal #3, "Good Health and Well-Being," focuses on ensuring healthy lives and promoting well-being for people of all ages. This includes addressing critical health challenges such as reducing maternal and child mortality, combating infectious diseases, ensuring universal access to healthcare, and promoting mental health.

Relating this to a robotics hackathon, participants can explore how robotics and technology can advance Goal #3. For example, teams could develop robotic solutions for improving access to healthcare in remote areas, automating health monitoring, aiding in surgical procedures, or providing mental health support through AI-driven companions. The hackathon serves as a platform to merge innovation with global impact, fostering creative solutions to promote health and well-being worldwide.

Challenge Description

Using the background information (as well as other resources) as a basis, your task is to create a solution that aligns with the targets set out in **Goal #3** and the open challenge theme of **Good Health and Well-Being**. Participants should explore how robotics and technology can advance Goal #3. For example, teams could develop robotic solutions for improving access to healthcare in remote areas, automating health monitoring, or aiding in surgical procedures.

We are looking for solutions that incorporate the three core aspects of robotics: **perception** (sensing the world), **reasoning** (making decisions based on perception), and **actuation** (affecting the environment in a meaningful way). On top of prototype construction, you must justify your solution with a **brief 7 minute pitch** on your design that also justifies how each of these aspects are met.

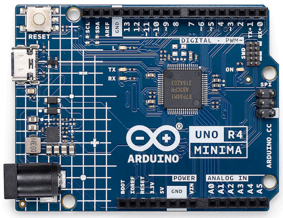
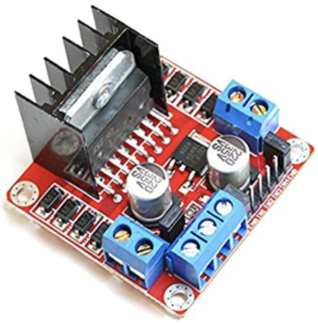
Judging Criteria

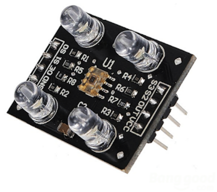
1. Pitch
    a. Framing: Does the solution align with Goal #3? Is the problem and/or solution well-defined, impactful, and backed by relevant data or research? (/15)
    b. Design:
        - Effectiveness: How likely is it that the solution will actually solve the problem? (/20)
        - Feasibility: Is there a plan for how to actually implement the solution? How realistic is it? (/10)

2. Prototype
    a. Construction: How well is the prototype constructed? Is it falling apart? (/10)
    b. Demonstration: Does the prototype demonstrate what it is intended to? Does it get the idea of the solution across? (/20)
    c. Robot aspects: Does the prototype use aspects of perception, reasoning, and actuation? (/15)
3. Being on time: -1pt / min late (/10)

* While we allow you to use open-source libraries / frameworks, **it is forbidden to copy others' code** in the logical layer. Generative AI is allowed in UTRA Hacks.

Hardware Documentation

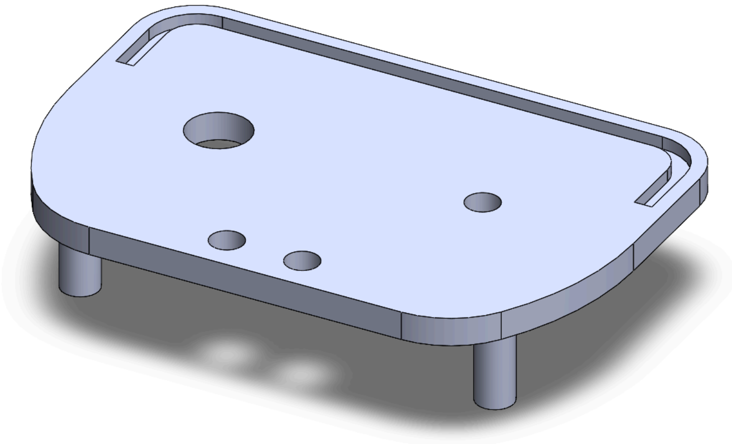
Capture the Flag Challenge		
Component	**Quantity for Each Kit**	**Documentation / Data Sheet**
Arduino Uno R4 	1	Data Sheet Other Resources
JGA25-370 Gearmotor 	2	Data Sheet
L298 Motor Driver 	1	Resources Tutorial
SG90 Servo motor 	1	Data Sheet
TCS230 Color Sensor	1	Data Sheet

Capture the Flag Challenge		
Component	**Quantity for Each Kit**	**Documentation / Data Sheet**
		Tutorial
Ultrasonic Sensor 	1	Data Sheet Tutorial
Breadboard	1	
9V Battery + Snap Connector	1	
Resistor	Multiple	
Chassis	1	
M2 Screws and Nuts	10	
Castor Ball	1	
Caster Standoff	4	
Wheels	2	
White LED	1	

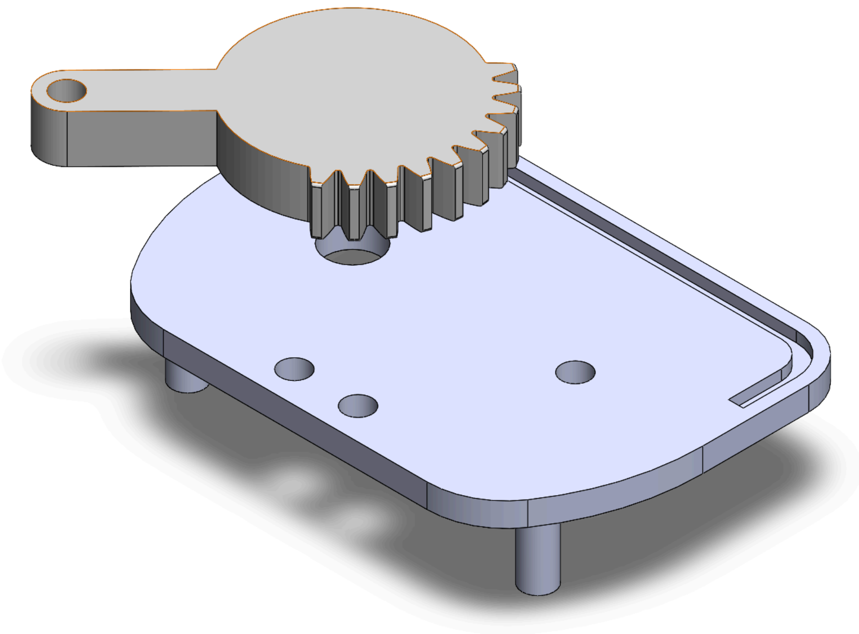
Claw Assembly Guideline

This guide should help you assemble the claw using the parts you were given for the capture the flag challenge. If you're having any trouble assembling the claw, please don't hesitate to reach out to one of us!

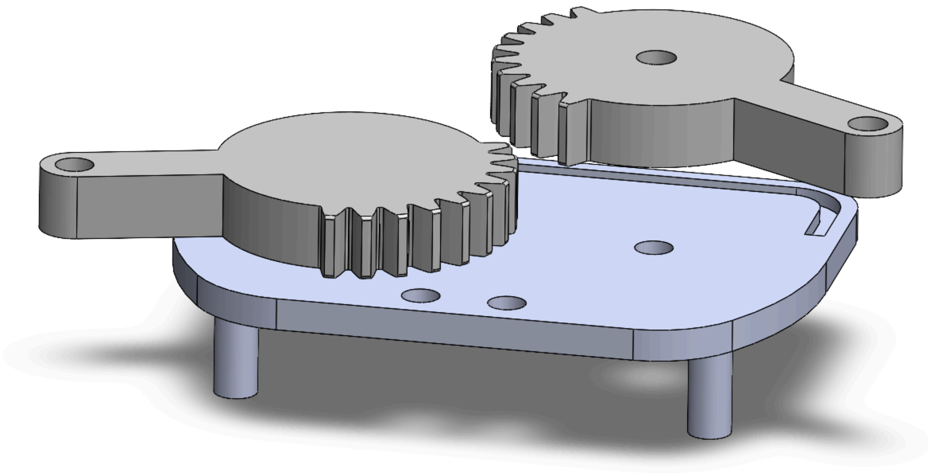
One disclaimer before you start. Some of the pieces may fit loosely, and this can cause the claw to fall apart. If this is the case, feel free to use glue to hold the assembly together. Please be thoughtful with how/where you glue, you don't want any moving parts to get stuck!



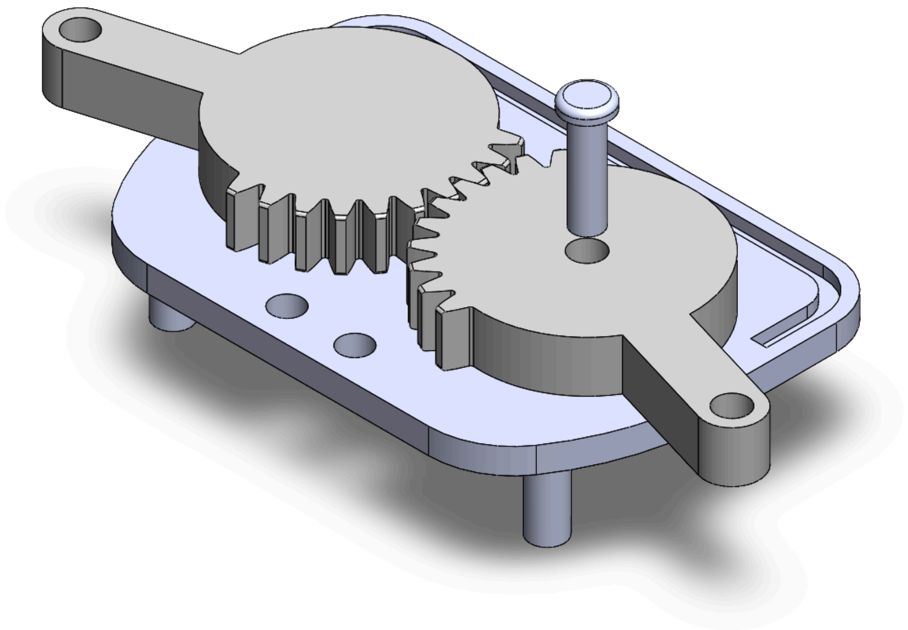
Step 1: Lay the base for the claw on a flat surface.



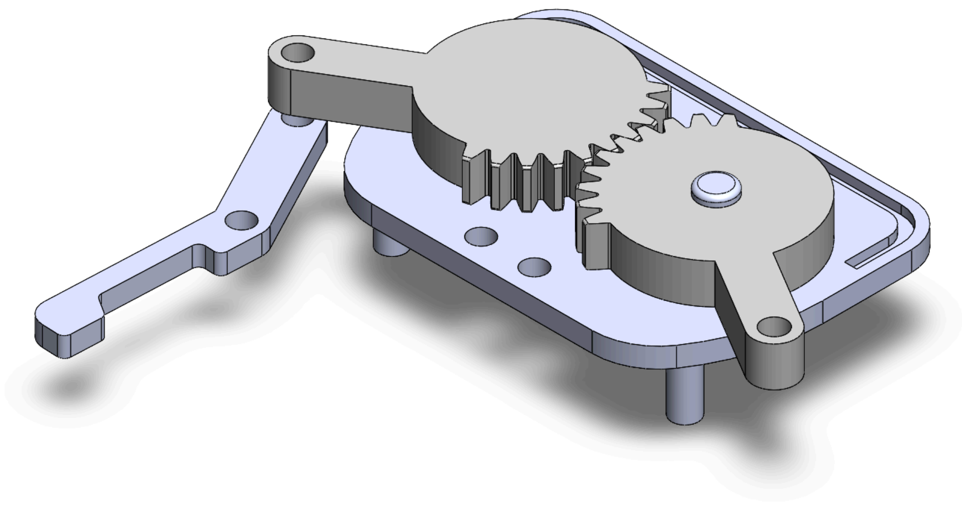
Step 2: Place the gear with the hub into the largest hole in the base.



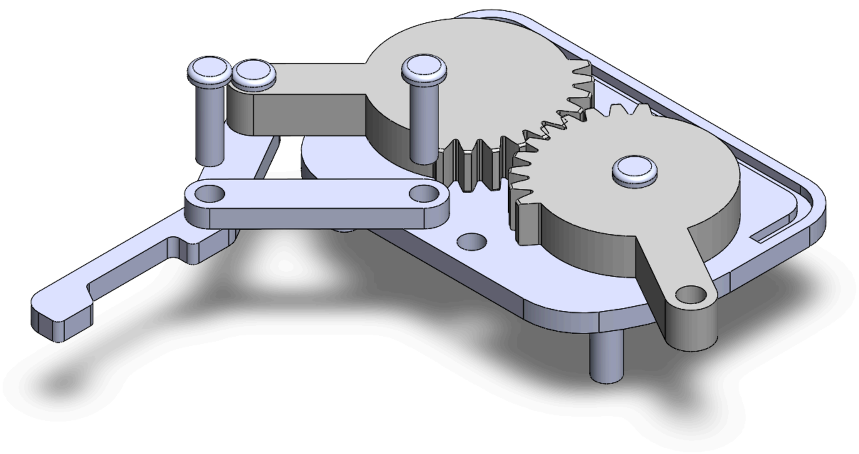
Step 3: Place the gear without the hub on the base, ensuring the hole in the gear is concentric with the hole in the base. Make sure that the two gears look symmetrical when viewed from above.



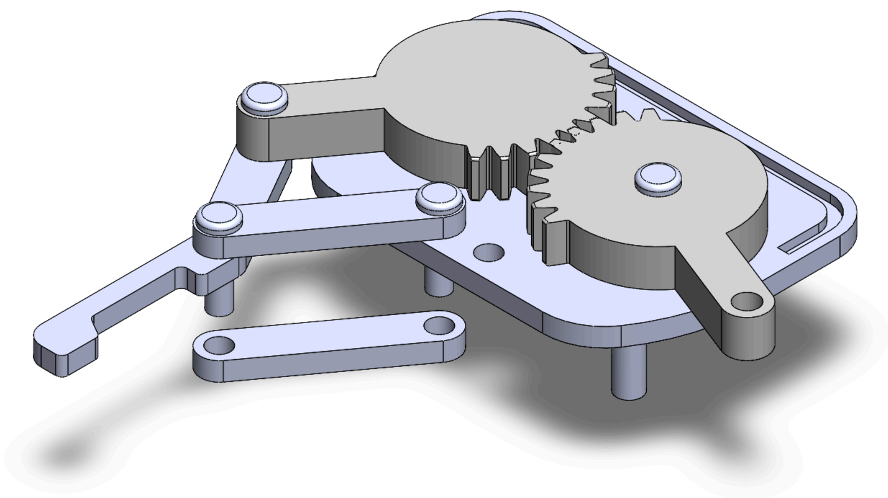
Step 4: Pin the second gear into the base.



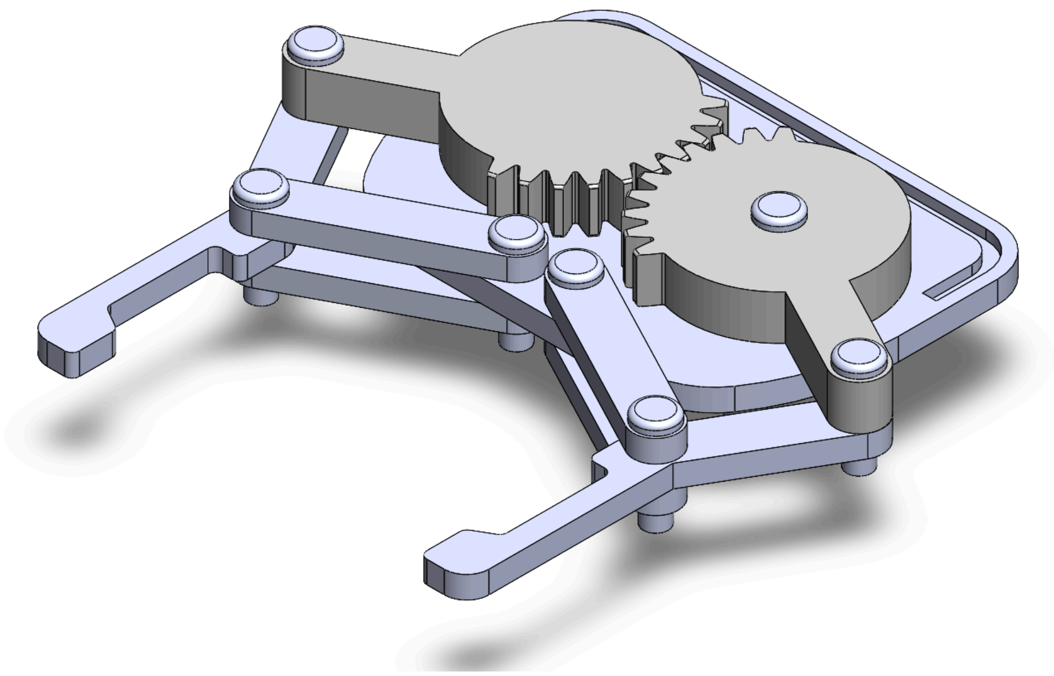
Step 5: Place one grabber under one of the gears, ensuring the holes are coincident. Pin the grabber to the gear.



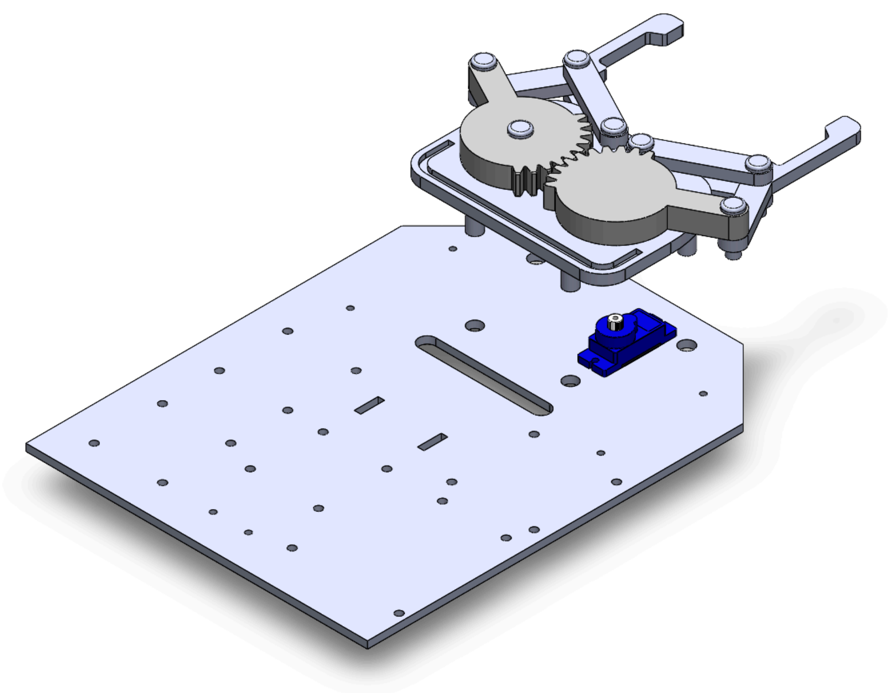
Step 6: Place one straight support across the grabber and base, pinning it on both ends.



Step 7: Push another straight support from under the claw.



Step 8: Repeat this process for the other gear.



Step 9: Insert the hub of the first gear into the shaft of the servo motor. The 4 supports of the base of the claw should align with the 4 holes on the robot body.