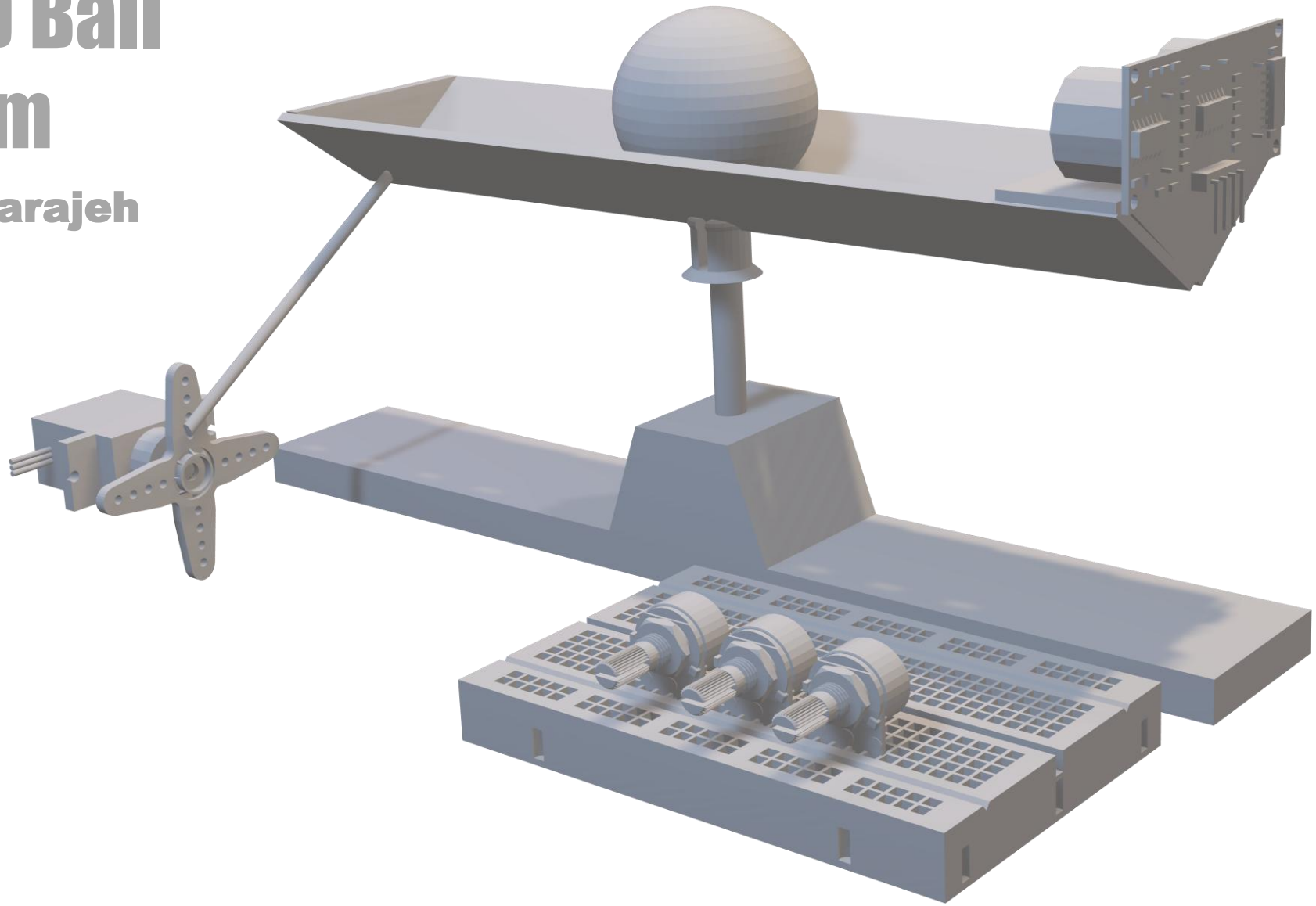
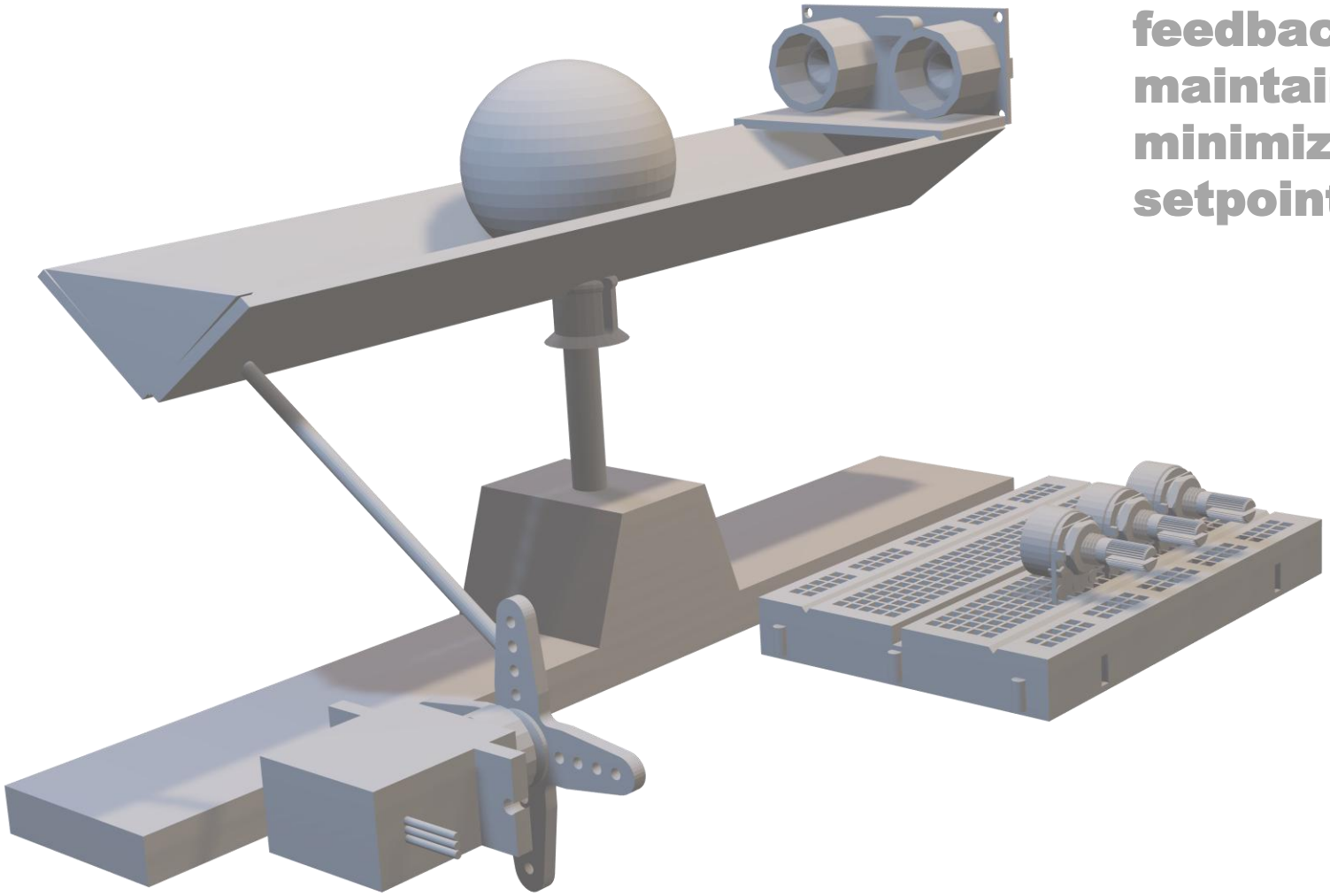
Model-Based PID Ball Balancing System

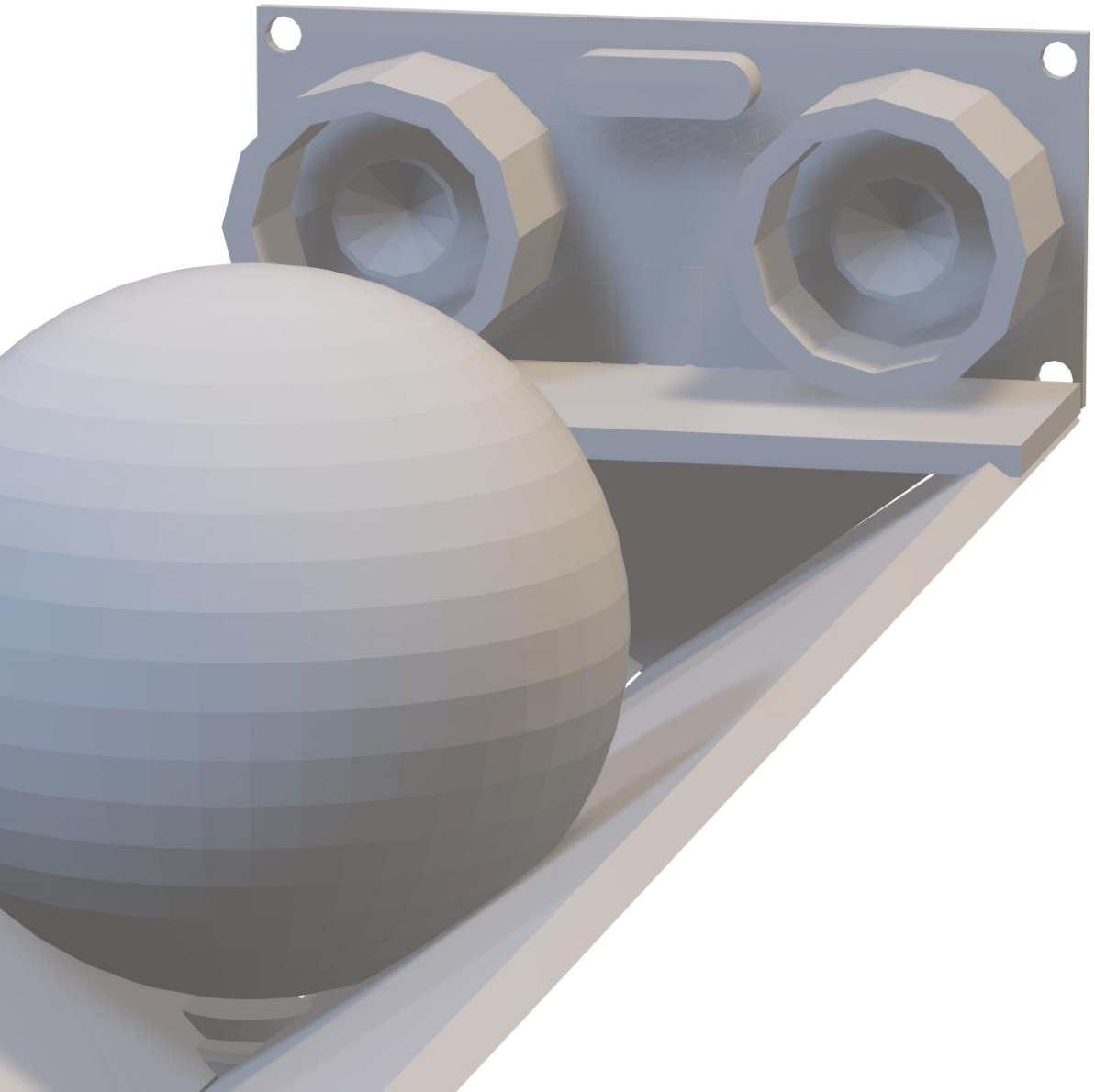
Qabas Ahmad & Selen Qarajeh





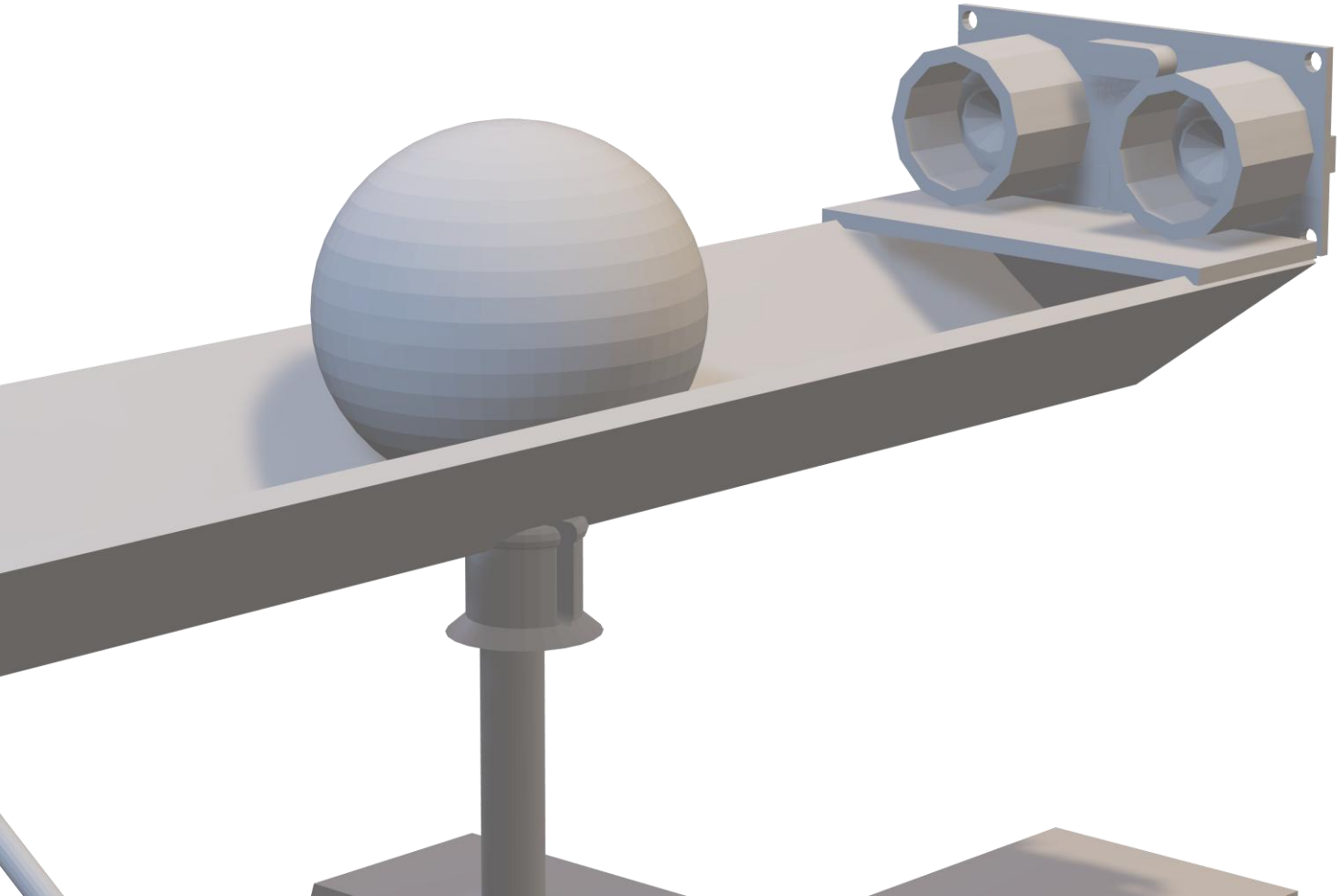
A PID controller is a type of feedback control system used to maintain a desired output by minimizing the difference between a setpoint and the actual value.

The PID controller uses input from a sensor to detect the ball's position and sends commands to a motor to adjust the platform’s angle.



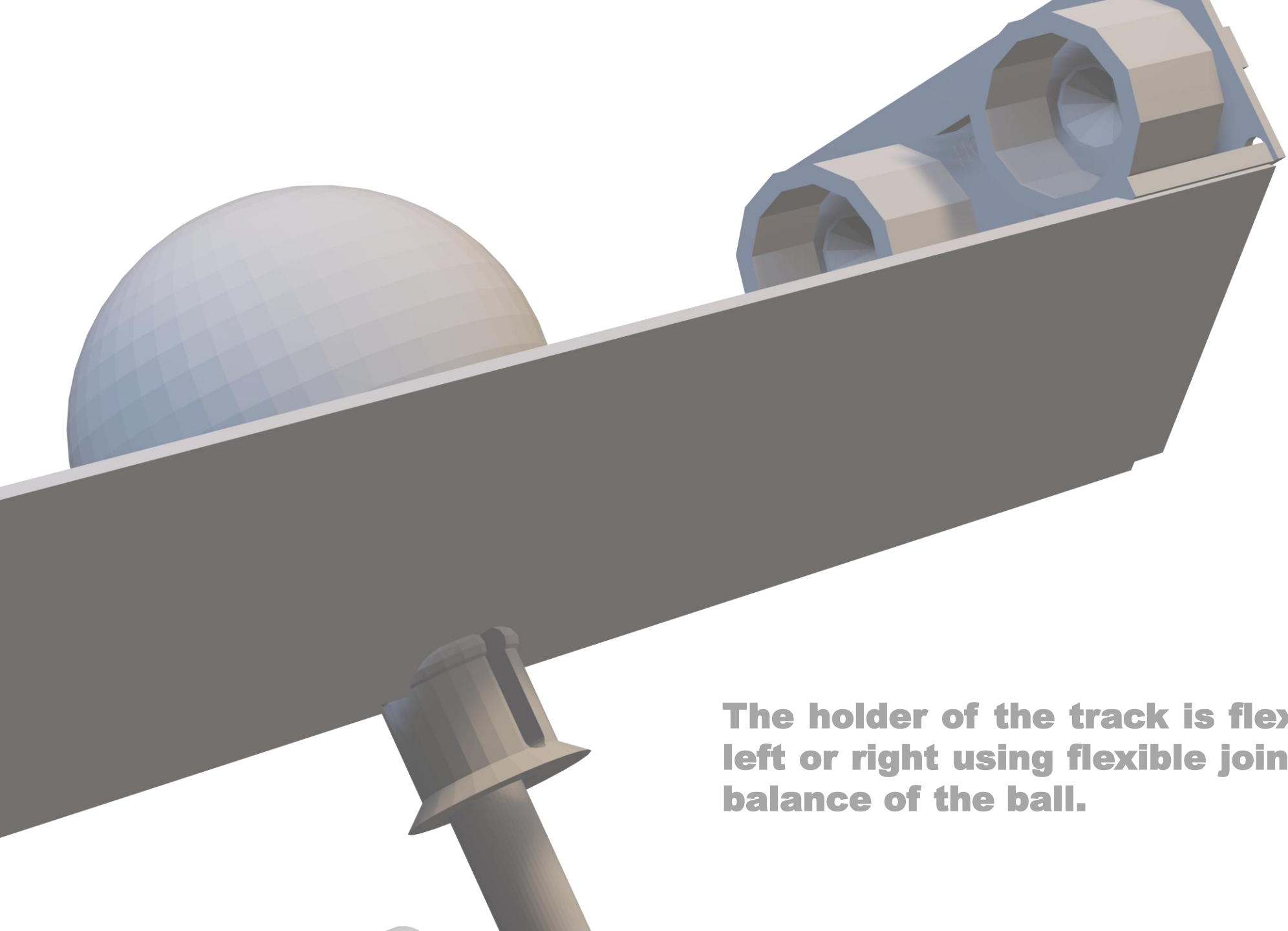
the ultrasonic sensor is used to measure the distance between the sensor and the ball in real time.

This distance data is crucial for the PID controller, as it represents the ball's current position on the track and is used to calculate the error that determines how the platform should tilt.

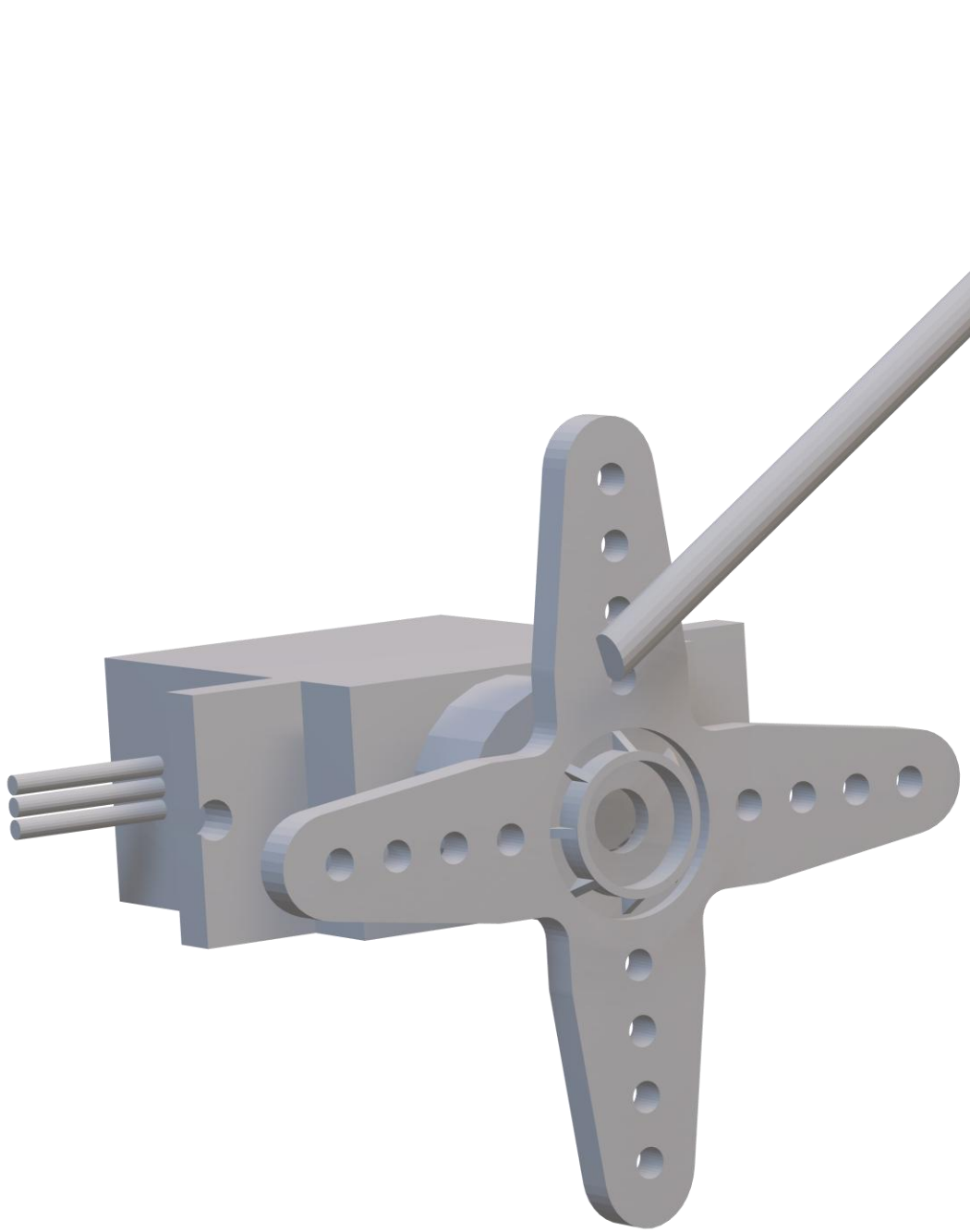


The two platforms connected at 90 degrees allow smooth ball movement along both axes, enabling precise PID control.

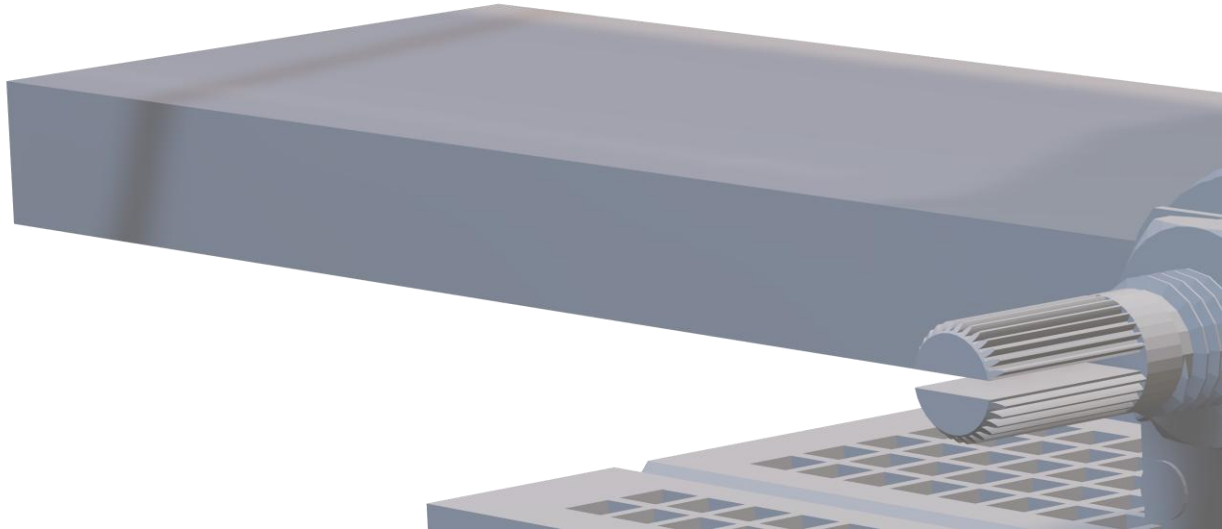
This setup also ensures the ultrasonic sensor has a clear, unobstructed view of the track for accurate position measurements.



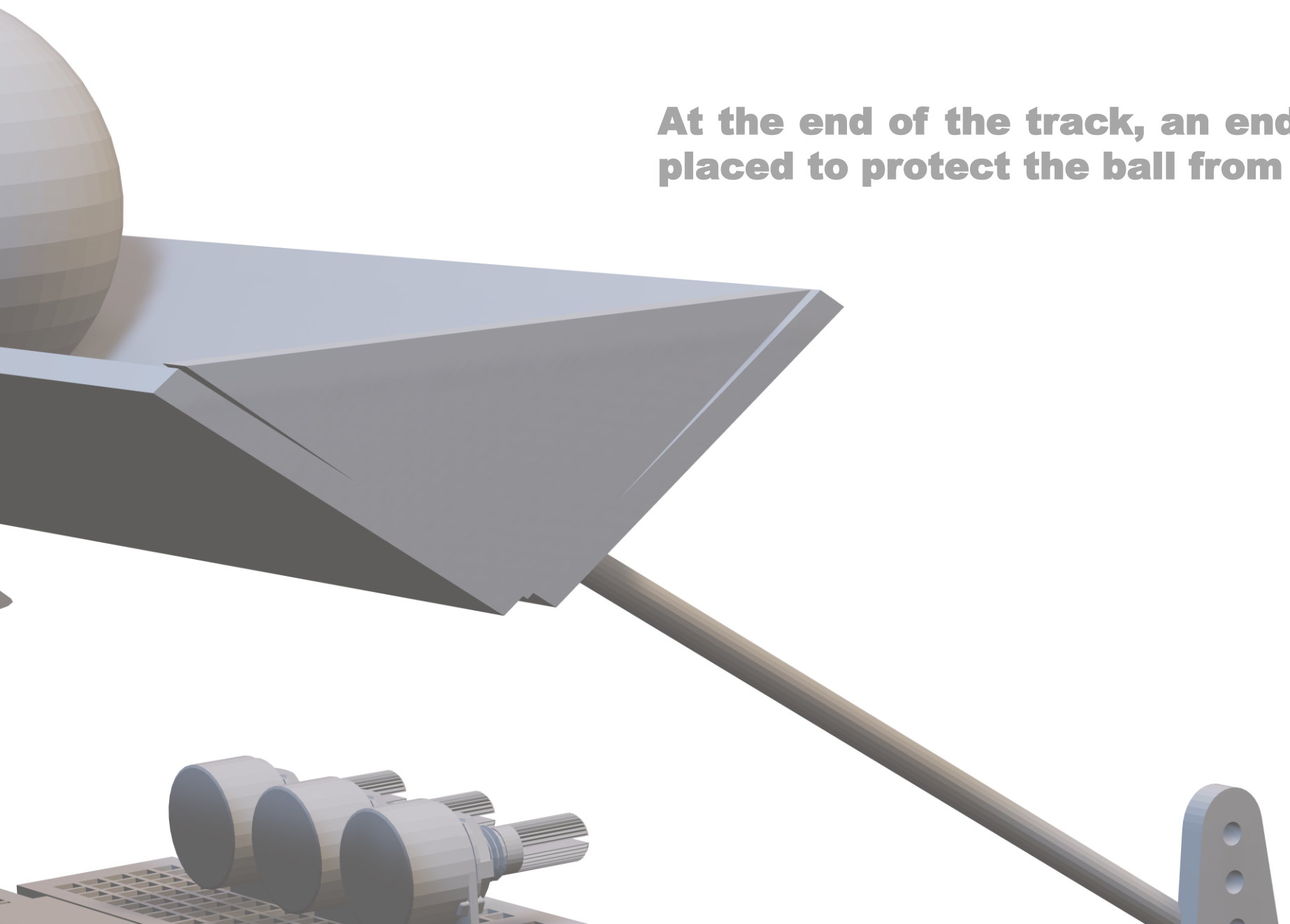
The holder of the track is flexible, can move left or right using flexible joints aiding in the balance of the ball.

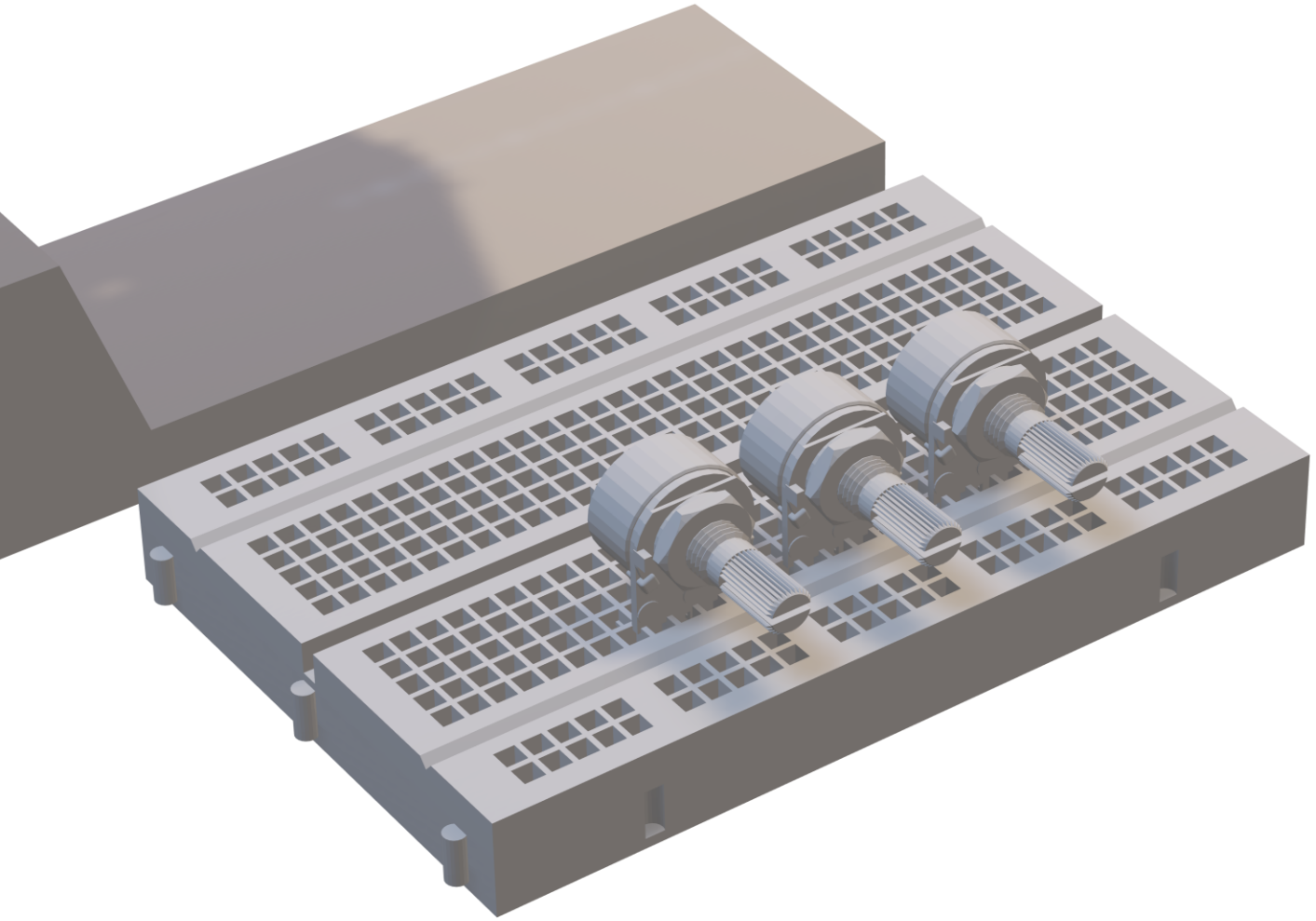


Based on the output from the PID controller, the servo adjusts its angle to tilt the track either left or right. This movement causes the ball to roll in the desired direction.



At the end of the track, an end stop should be placed to protect the ball from falling.

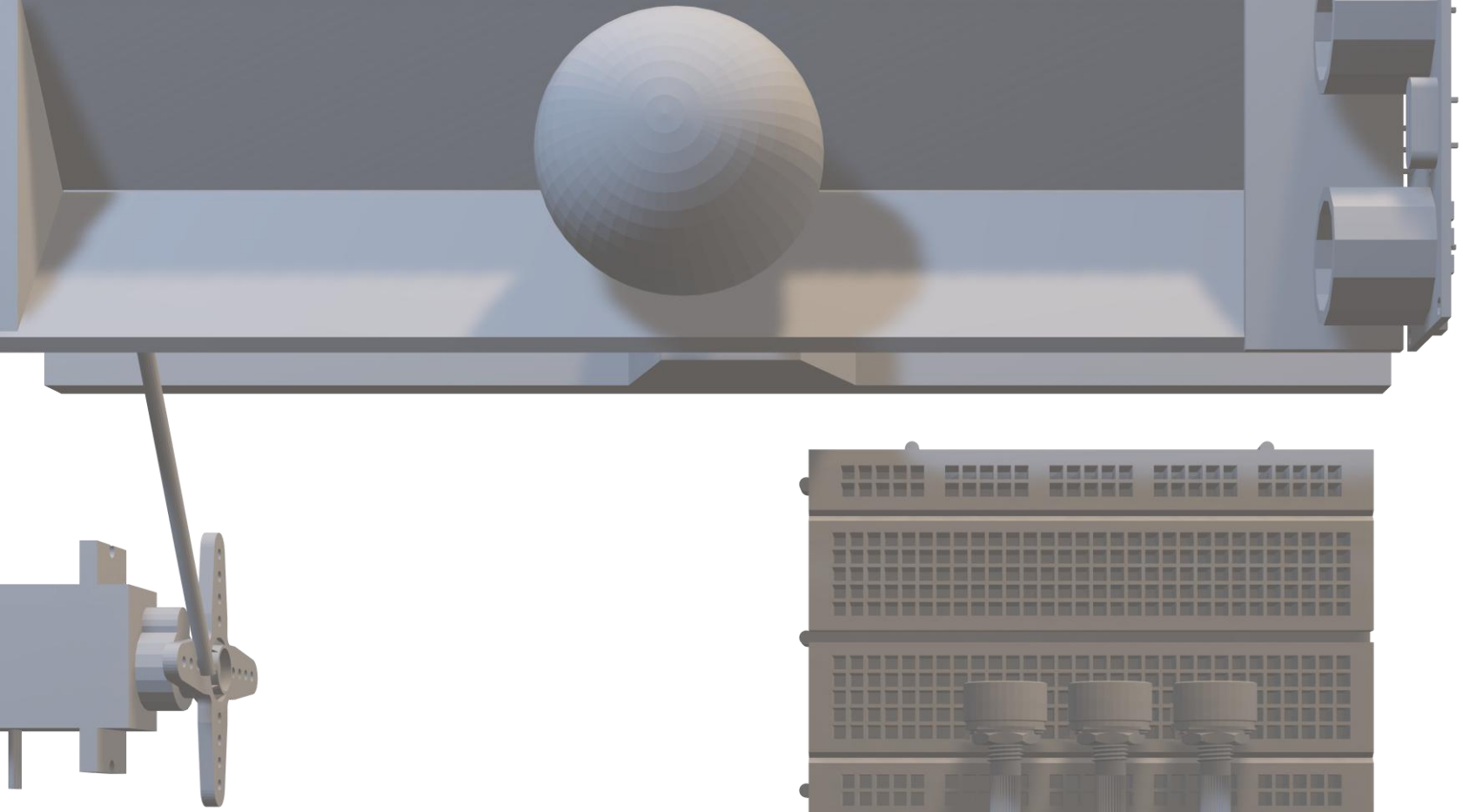




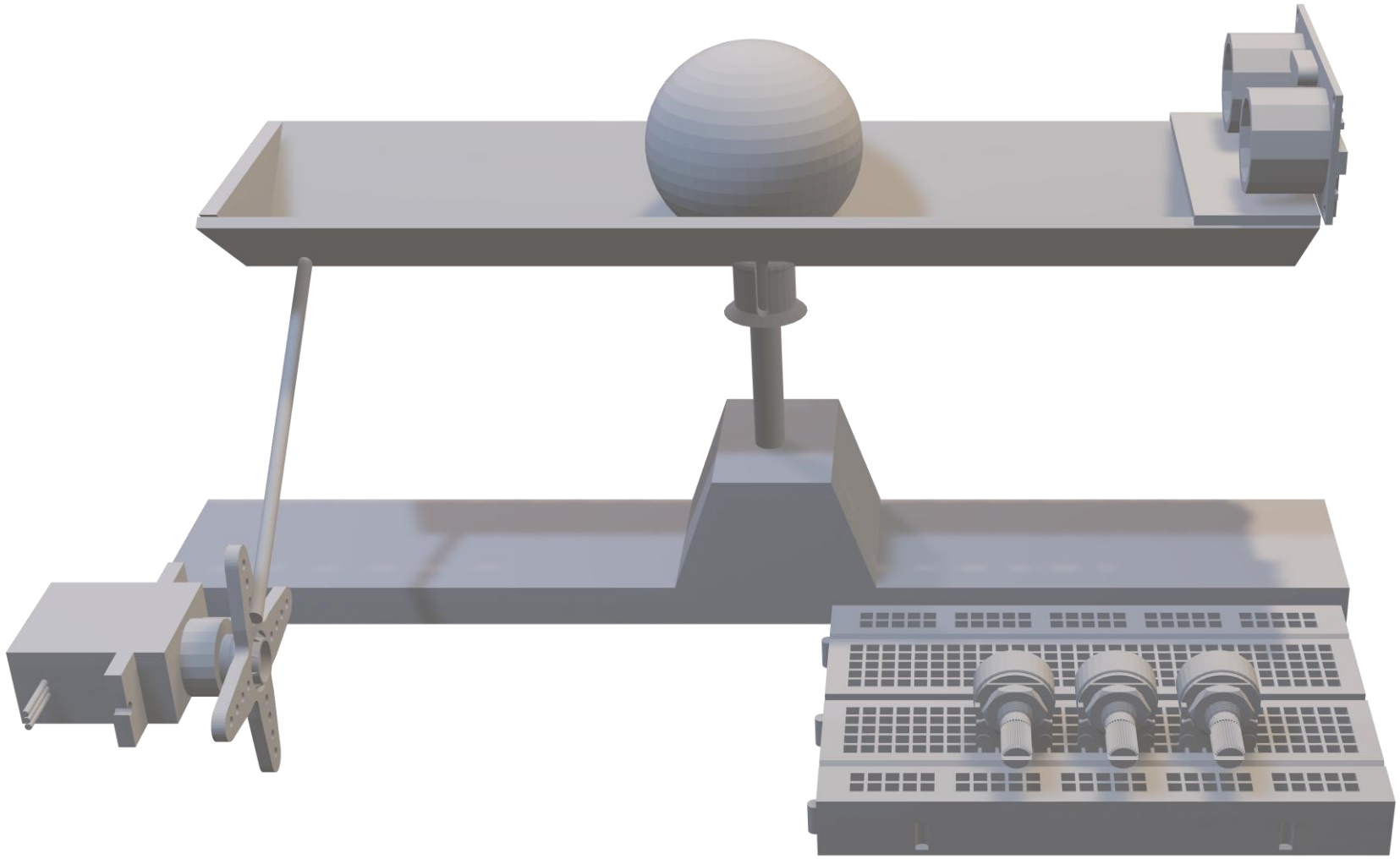
The potentiometers in this project are used to manually adjust the PID constants in real time.

This dynamic tuning helps optimize the system's responsiveness and stability without needing to reprogram the controller, making it easier to experiment and achieve better performance.

Using a wooden base as the plate for a PID ball balancing system is important because wood provides a stable and lightweight surface that minimizes external disturbances.



All the components in this project work together to form a real-time feedback control system. This coordinated interaction ensures the ball stays balanced by constantly sensing, computing, and correcting its position.



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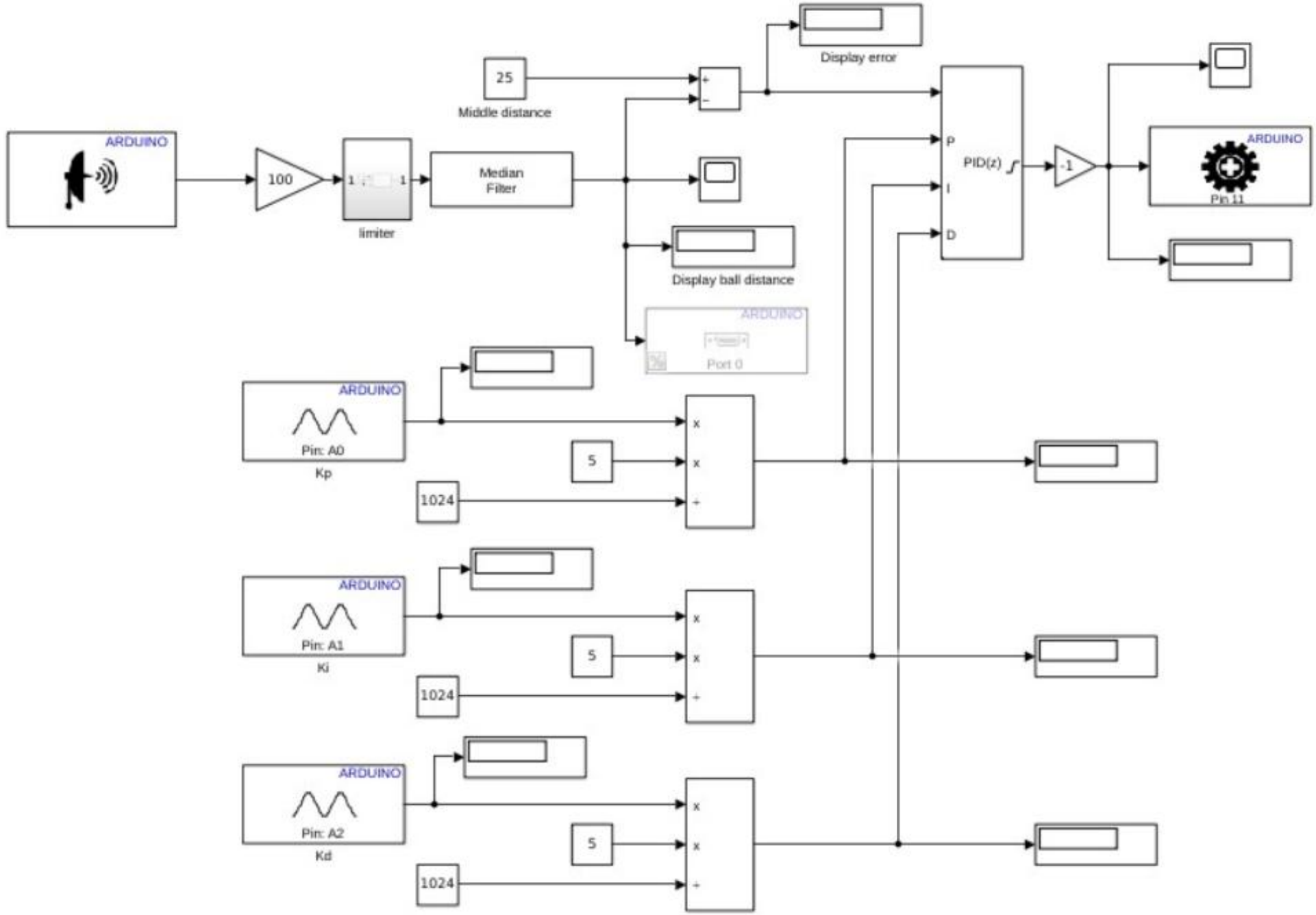
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Median
Filter
25
Middle distance
Display error
Display ball distance
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Port 0
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I
D
PID(z)
-1
ARDUINO
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