(A)CAD DESIGN SPECIFICATION

A. Base Plate

The base structure (shown in *Fig.8a*) is a hexagonal central frame specifically designed for a hexapod robot, incorporating six evenly spaced mounting bays for leg assemblies. The frame features internally ribbed walls to enhance strength while minimizing weight. Strategic cutouts and slots are included for efficient cable routing, secure component mounting, and further weight reduction. Measuring 196 mm across its widest points and 50 mm in height, the design provides a 150 mm internal span to accommodate servos and structural connections. Intended for 3D printing in PLA, it is recommended to use 40–50% infill to achieve an optimal balance between durability and weight for supporting the leg mechanisms.

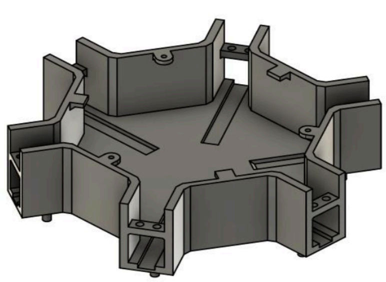

Fig.8a: Hexapod Base Plate Design

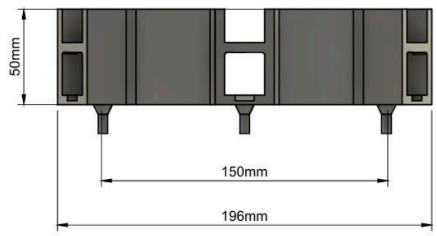

Fig.8b: Base Plate Design with Dimensions

B. Components Deck

The hexagonal upper chassis shell(shown in *Fig.9a*) is designed to enclose and protect the central electronics and sensor suite of the hexapod robot. It incorporates precision openings for cameras, LiDAR, and other sensing devices, as well as integrated mounting points for internal modules. The angled side panels enhance structural rigidity while enabling optimal sensor orientation and coverage.

This component is intended for 3D printing in PLA, with a recommended 30–40% infill to provide a balance between mechanical strength and reduced weight, supporting the robot's overall stability and energy efficiency.

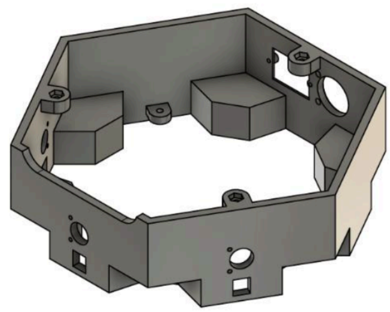

Fig.9a: Hexapod Components Deck Design

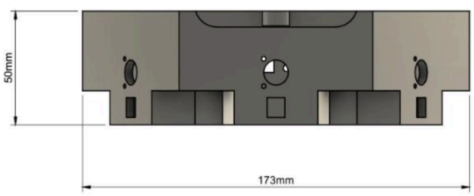

Fig.9b: Components Deck with Dimensions

C. Top Cover

The top cover plate (shown in *Fig.10a*) is a flat, hexagonal panel designed to mount securely over the upper chassis of the hexapod robot. It incorporates a central raised enclosure specifically engineered to house and protect the LiDAR unit and camera, ensuring both are optimally positioned for unobstructed sensing and data capture.

As a non-load-bearing component, the cover plate is intended for 3D printing in PLA with a recommended 20–30% infill. This provides sufficient rigidity for mounting and protection while keeping the structure lightweight, contributing to the robot's overall stability and energy efficiency.

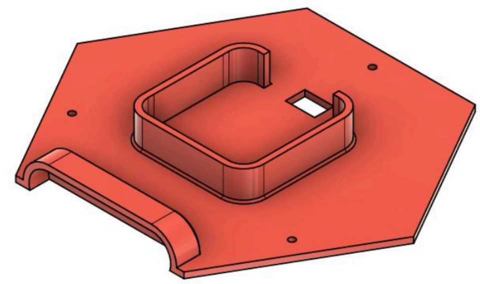

Fig.10a: Hexapod Top Cover Design

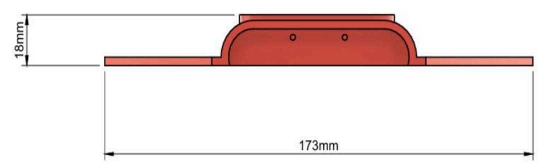

Fig.10b: Top Cover Design with Dimensions

D. Body Assembly

This assembly (shown in *Fig.11a)* integrates the base frame, electronics deck, and top cover into a compact, unified central module for the hexapod robot. The structure securely houses and protects all primary electronics while providing dedicated mounting points for vision sensors, ultrasonic sensors, and a LiDAR unit positioned on the top cover for maximum field of view.

The design incorporates strategically placed ports and cutouts for efficient cable routing, ventilation, and ease of maintenance. The reinforced hexagonal base offers robust and precisely aligned attachment points for all six leg assemblies, ensuring mechanical stability and balanced load distribution. This modular configuration enhances durability, optimizes sensor coverage, and streamlines integration within the overall robot architecture.

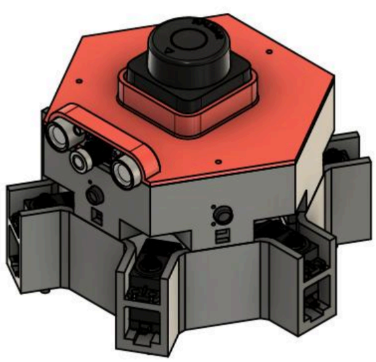

Fig.11a: Hexapod Body Assembly

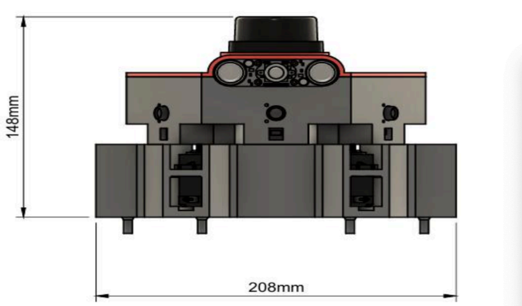

Fig.11b: Body Assembly with Dimensions

E. Legs

a) Coxa Joint Bracket

The coxa joint bracket (shown in *Fig.12a*) is a structural component of the hexapod leg assembly, engineered to connect the central chassis to the femur segment. It houses the servo motor responsible for horizontal leg rotation and incorporates a lower circular bore designed to seat a bearing, enabling smooth rotational movement while minimizing wear under load.

The bracket features reinforced wall geometry to withstand operational stresses, along with precisely positioned mounting holes for secure attachment to both the servo and the chassis. It is intended for 3D printing in PLA, with a recommended 50–60% infill to provide the necessary strength and durability for sustained torque loads and repetitive motion cycles.

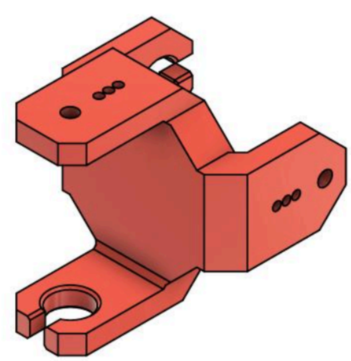

Fig.12a: Coxa Design (Leg)

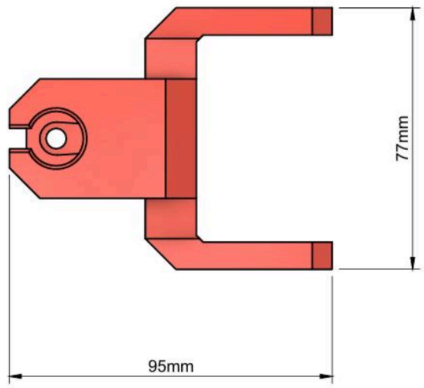

Fig.12b: Coxa Design (Leg) with Dimensions

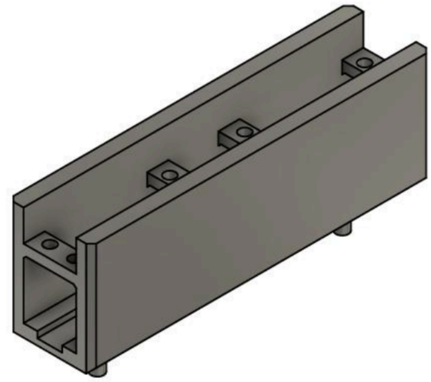

Fig.13a: Femur Design (Leg)

b) Femur Joint Bracket

The femur segment (shown in *Fig.13a*) is a critical link in the hexapod leg assembly, connecting the coxa bracket to the tibia. It features a reinforced hollow profile to minimize weight while preserving structural integrity. Servo mounting points are integrated at both ends: one end interfaces with the coxa servo to enable vertical leg movement, while the other accommodates a servo that actuates the tibia segment.

Internal ribbing within the structure enhances rigidity and ensures even load distribution during operation, improving durability under dynamic conditions. The component is intended for 3D printing in PLA with a recommended 40–50% infill, providing an optimal balance between strength and weight for active load-bearing performance.

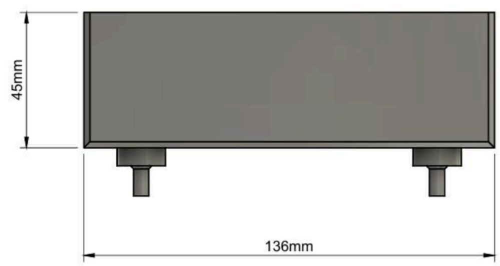

Fig.13b: Femur Design (Leg) with Dimensions

c) Tibia Joint Bracket

The tibia segment (shown in *Fig.14a*) forms the lower section of the hexapod leg assembly, linking the femur to the foot or end-effector. It is designed as a solid PLA structure to provide maximum rigidity and resist bending under operational loads. The upper end features a precision-engineered servo horn interface, enabling direct motion transfer from the femur's tibia-actuating servo for smooth, controlled leg extension and retraction.

This component is intended for 3D printing in PLA with a recommended 40–50% infill, offering an optimal balance between strength and weight for reliable performance in active load-bearing conditions.

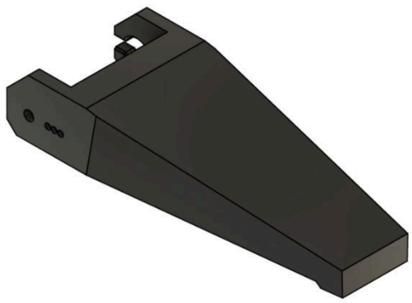

Fig.14a: Tibia Design (Leg)

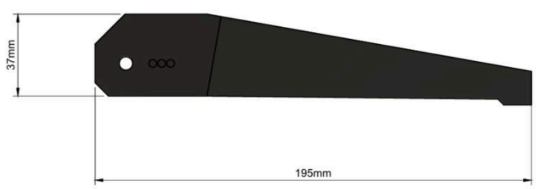

Fig.14b: Tibia Design (Leg) with Dimensions

F. Leg Assembly

The hexapod leg assembly (shown in *Fig.15a*) is a three-part PLA structure designed for precise, stable, and adaptive movement across rough and uneven terrain. It consists of the coxa for horizontal rotation, the femur for vertical lift, and the tibia for extension to the ground. Each segment incorporates dedicated servo mounts for independent motion control, enabling complex gait patterns and smooth navigation over obstacles.

This modular leg assembly design allows each segment to operate independently, supporting precise locomotion, improved stability, and adaptability for challenging terrain in humanitarian and exploration missions.

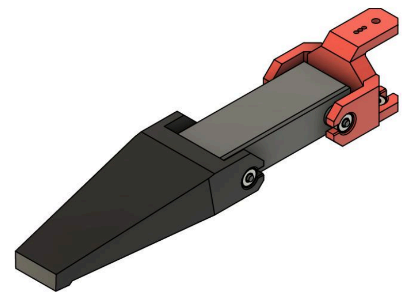

Fig.15a: Leg Assembly

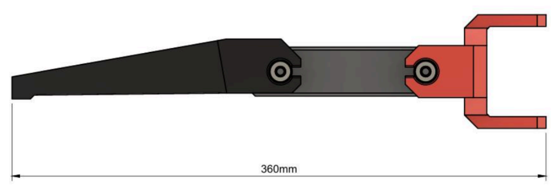

Fig.15b: Leg Assembly with Dimensions