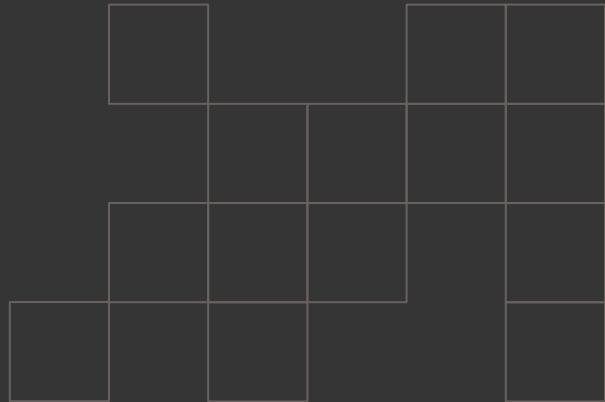


Team 2 Design Proposal

Yecheng Zheng, Daniel Lazaro, Hongfei Liu, Hongru Liu

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Project description

- Project: Compact, legged human-carrying assistive mobility robot for *Kinematic/Kinesthetic* by AXIS Dance Company
- Purpose: Transport a wheelchair user without wheels using articulated legs
- Capabilities: Expressive, choreographed motion + zero-radius turning
- Artistic framing: Assistive tech as an artistic medium (not “fixing” disability)
- Design goals: Compact, safe, and stage-ready; autonomous features

Design requirements

Locomotion & Motion

Leg-driven locomotion (auxiliary wheels allowed for support)

Forward / backward motion

Zero-radius turning (CW & CCW)

User & Safety

Seated or cross-legged

User fully off ground, clear sight

Safe and stable for live performance

Size, Weight & Payload

Max footprint: 5' × 5'

Rider height: 2–3 ft above ground

Robot mass \leq 150 lb

Payload capacity \geq 170 lb

Performance & Transport

Navigate to target within 6" in accuracy in < 1 min

Speed range: 1–4 mph

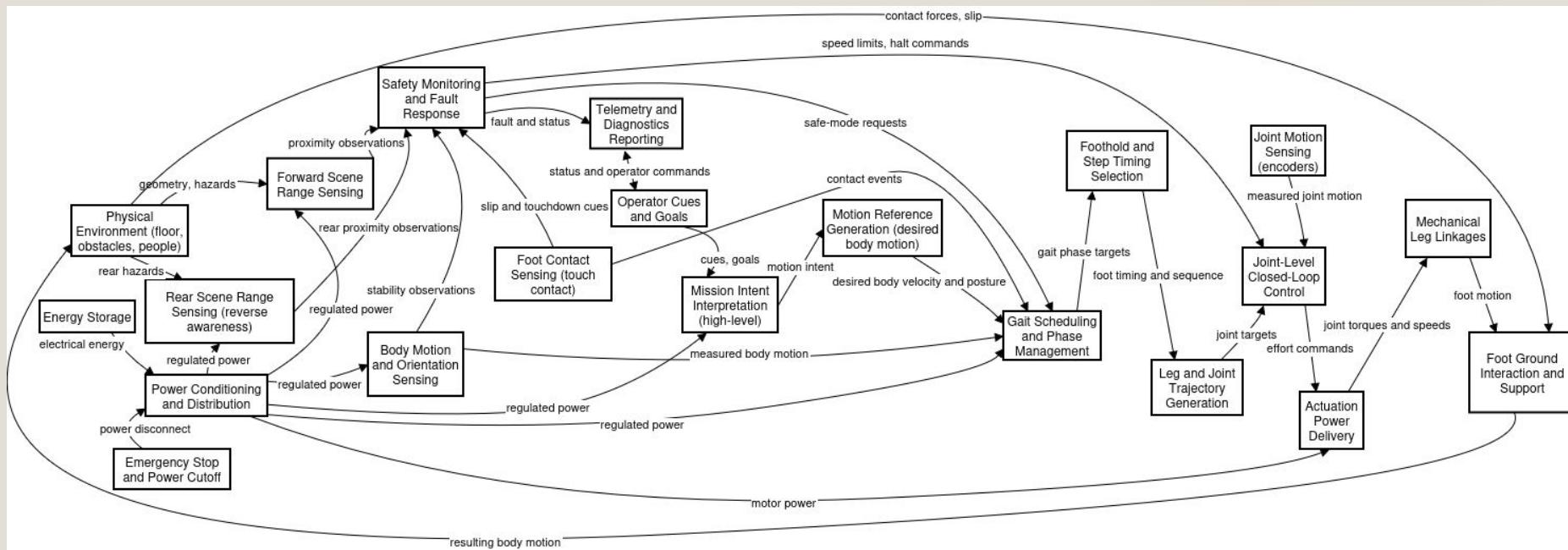
Ships in 3' × 3' × 3' case (\leq 7 parts)

Fits through 36" door when folded

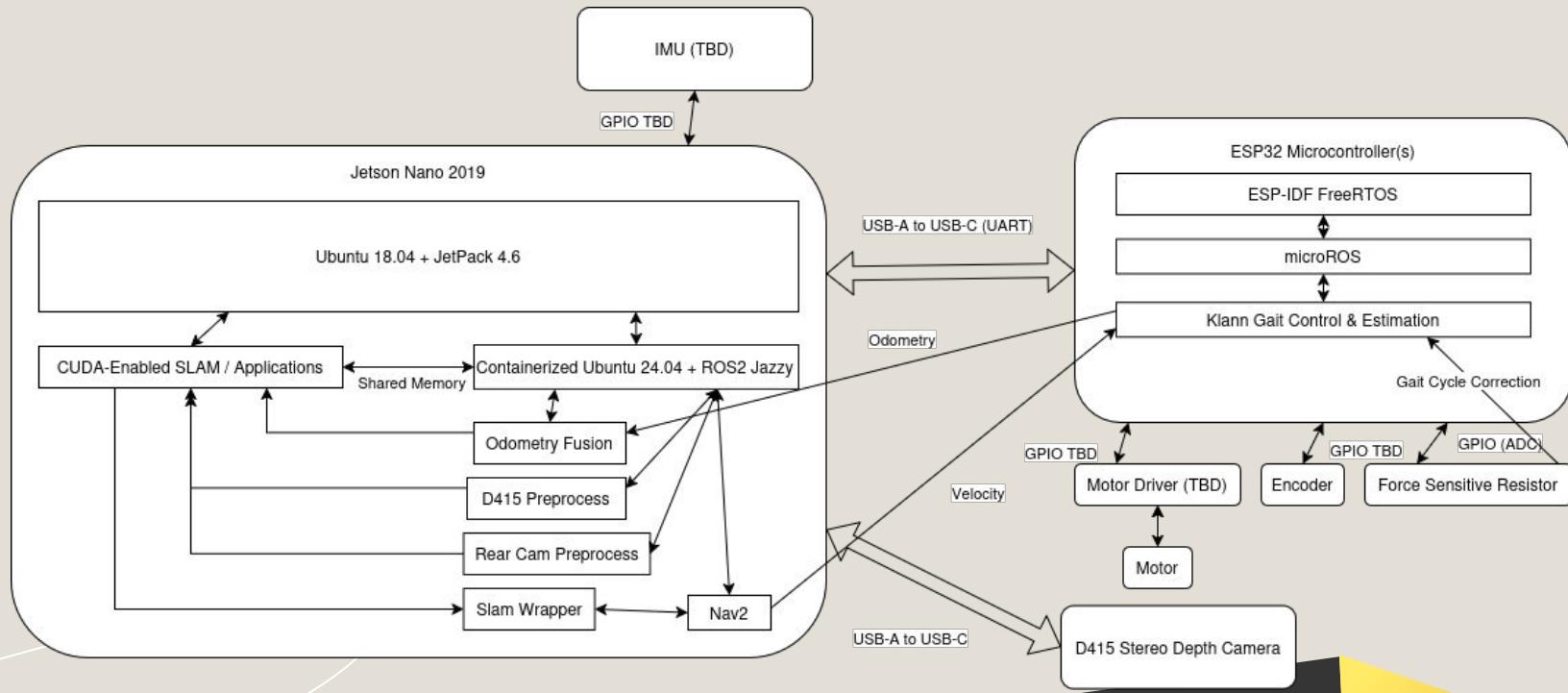
Design trade studies

	Our Design	Daft Punks	Dancing Queens
Locomotion mechanism	Klann linkage	Fully actuated articulated legs	Fully actuated articulated legs
Actuation per leg	1 motor drives 2 legs per side	Stepper motor + linear actuator per leg	2 stepper motors per leg
Gait generation	Mechanically encoded via Klann linkage (continuous motion)	Software-defined tripod gait	Software-defined tripod gait
Actuation	Mechanically coupled	Independently actuated	Independently actuated
Turning	Differential motor speed (tank-style)	Gait modification	Gait modification

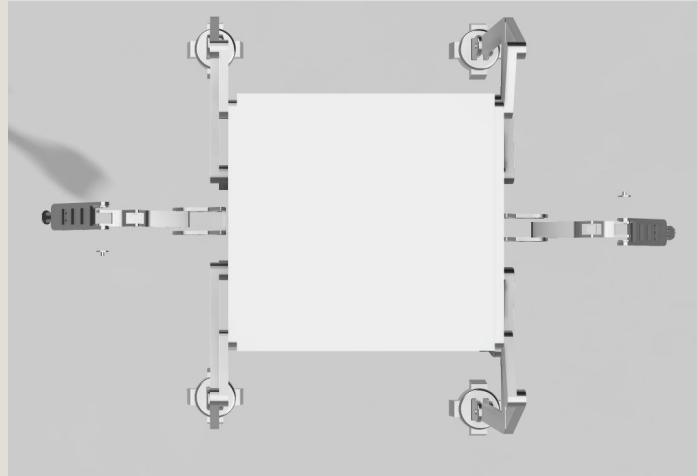
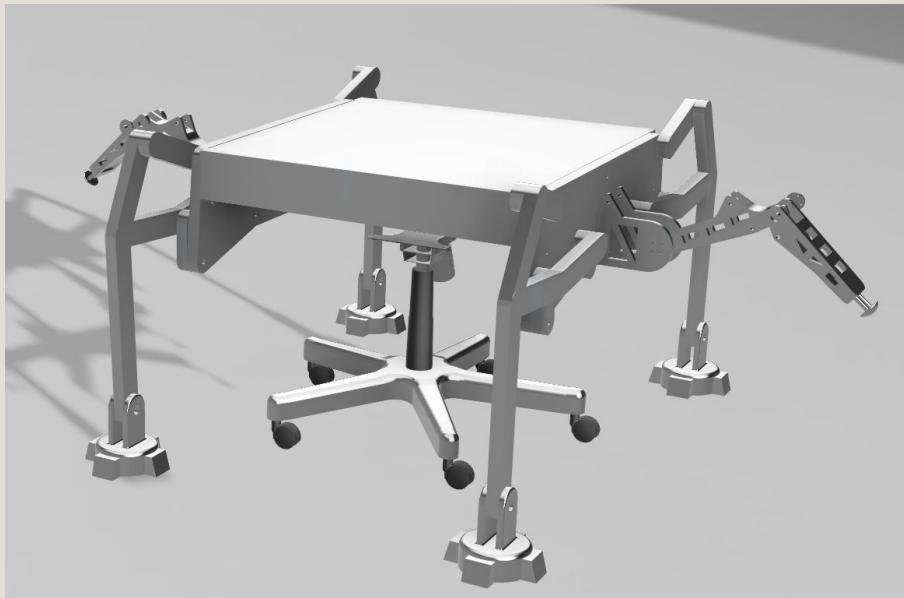
Functional architecture



Cyber Physical architecture

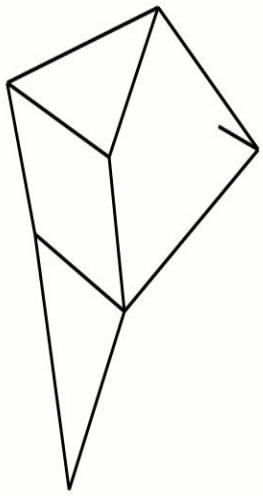


System depiction - Overview

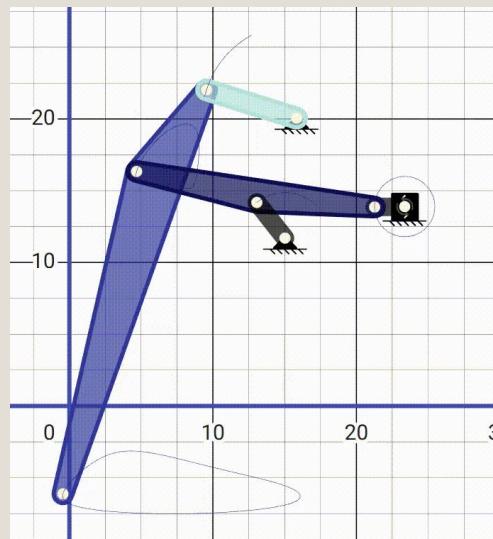


System depiction - Klann Linkage Style Leg

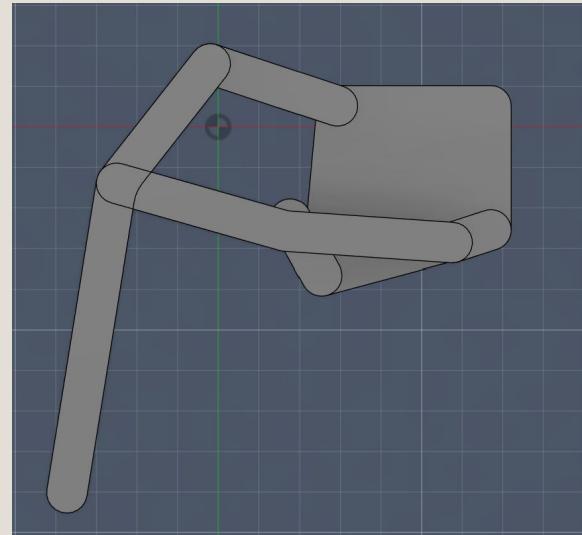
Jensen Linkage



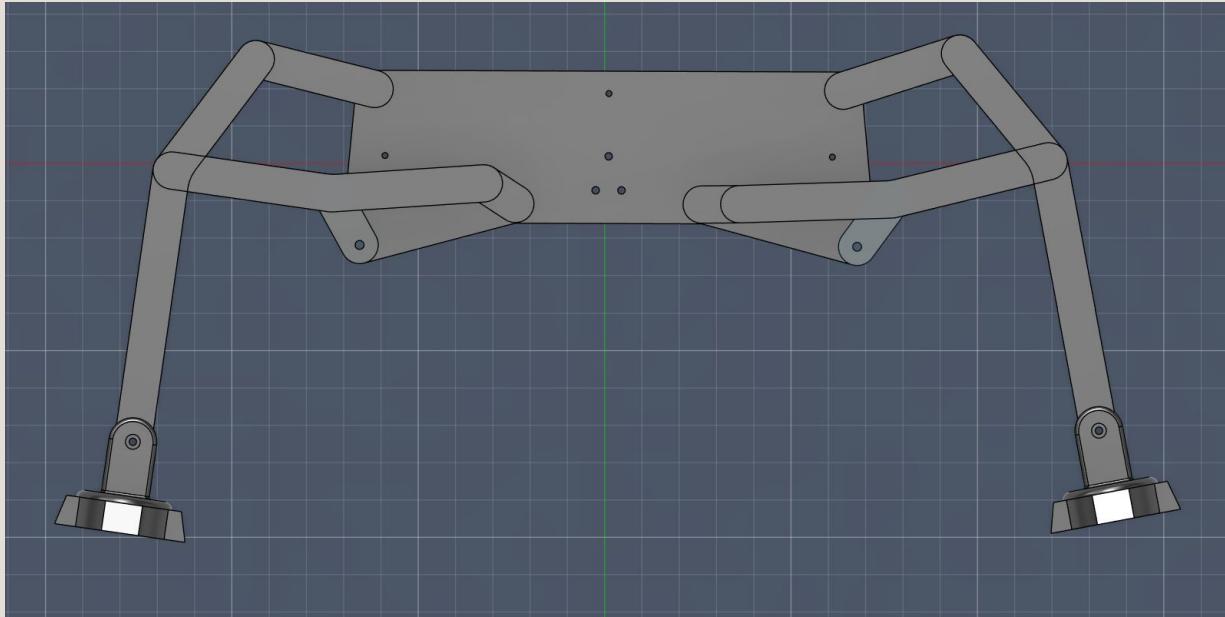
Klann Linkage



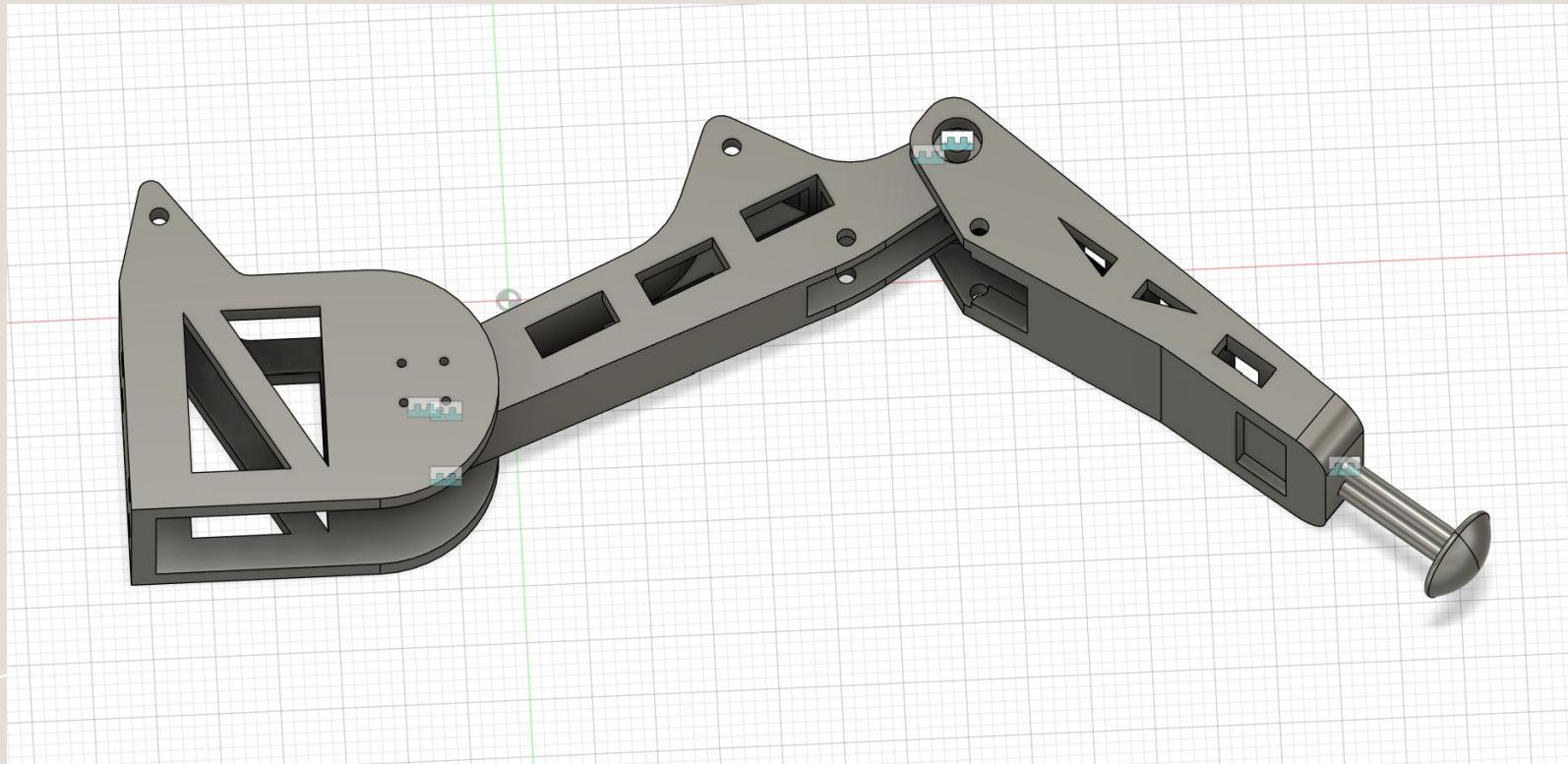
CAD Model



System depiction - Klann Linkage

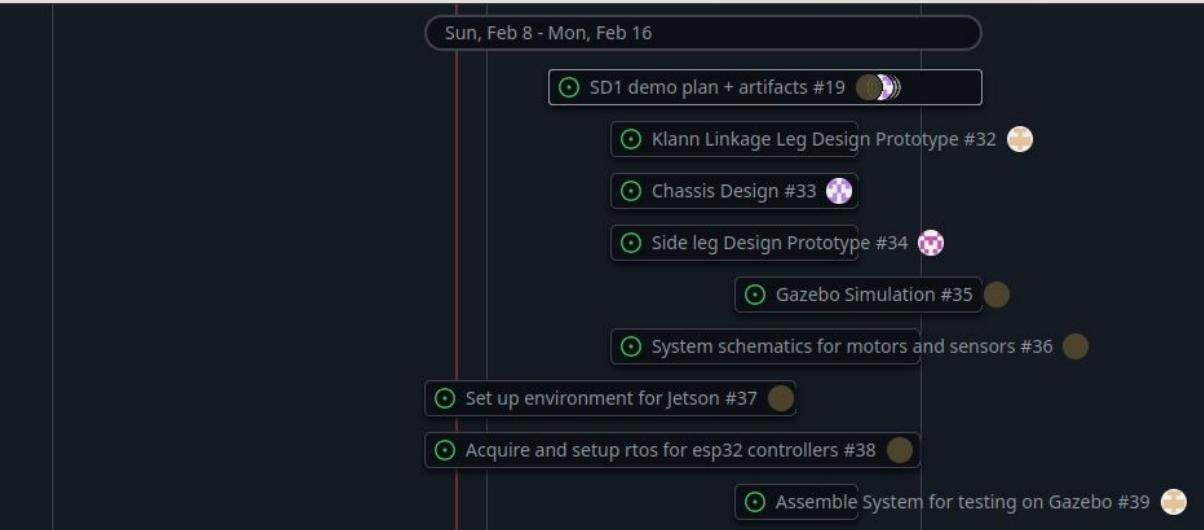


System depiction - Side Legs



Schedule & Responsibilities

System Demo 1		...
33	SD1 demo plan + artifacts	#19
34	Klann Linkage Leg Design Prototype	#32
35	Chassis Design	#33
36	Side leg Design Prototype	#34
37	Gazebo Simulation	#35
38	System schematics for motors and sensors	#36
39	Set up environment for Jetson	#37
40	Acquire and setup rtos for esp32 controllers	#38
41	Assemble System for testing on Gazebo	#39



Estimated budget - Mechanical

Item	Description / Notes	Qty	Unit Cost (USD)
DC gear motors (Klann drive)	Rotary motors driving Klann crank shafts	2–4	\$40 – \$80
Motor mounting brackets	Motor-to-frame mounts	2–4	\$15 – \$50
Shaft couplers	Motor-to-crank shaft couplers	2–4	\$10 – \$30
Crank shafts	Steel or aluminum shafts	2–4	\$15 – \$50
Pillow block / radial bearings	Support crank shafts	4–8	\$10 – \$40
Shaft collars	Axial shaft retention	6–12	\$5 – \$15
Klann linkage plates	Aluminum / G10 link sets	4 sets	\$25 – \$120
Shoulder bolts / joint pins	Klann pivot joints (M5–M8)	4 sets	\$15 – \$60
Bearings / bushings	Flanged bearings or bronze bushings	4 sets	\$20 – \$80
Spacers & washers	Aluminum / nylon spacers	4 sets	\$5 – \$20
Klann foot pads	Rubber / TPU feet	4	\$5 – \$25
Klann leg mounting brackets	Leg-to-frame interface	4	\$10 – \$50
Linear actuators (motor inside)	100–200 mm stroke, 300–1000 N	2	\$40 – \$250
Clevis / rod ends	Actuator end joints	4	\$10 – \$40
Actuator mounting brackets	Frame & leg mounts	2 sets	\$20 – \$60

Estimated budget - Cont.

Item	Description / Notes	Qty	Unit Cost (USD)
Battery	Powering systems	1	\$150
Motor Drivers	drive motor	3	10
CSI cameras	rear camera	2	20
Misc Cabling	connect everything		20
Actuator leg structures	Links / tubes for actuator legs	2 sets	\$20 – \$60
Actuator leg bearings	Pivot bearings / bushings	2 sets	\$10 – \$30
Actuator leg foot pads	Rubber / TPU feet	2	\$5 – \$25
Main frame extrusions / plates	6061 aluminum	1 set	\$150 – \$600
Side plates / hubs	Thick leg-mount plates	2–4	\$40 – \$200
Cross bracing / gussets	Structural stiffening	1 set	\$30 – \$150
Standoffs / spacers	Frame spacing	1 set	\$20 – \$100
Fastener assortment	M3–M8 bolts, nuts, washers	1 lot	\$50 – \$200
Thread inserts	Heat-set or press-fit	1 lot	\$10 – \$60
Adhesives & consumables	Loctite, epoxy	1 lot	\$10 – \$40
Office Chair	1	1	\$80
Fabrication allowance	Extra material / mistakes	—	10–25%
Estimated total	/	/	\$670-\$1300

Risk management plan

1 – Side leg size/geometry is not finalized

- Wrong length/placement can cause interference or unstable support
- Actuation choice unclear (hydraulic / pneumatic / motor / linear actuator)

2 – Materials + joint hardware not selected

3 – Late decisions delay ordering and integration

4 – Budget creep

