

BILL OF MATERIALS — Robotics Traveling Van (RTV) Capstone Project

Project: Robotics Traveling Van (RTV) | Two-Robot Assembly | Spring 2026

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HOW TO READ THIS BOM: Column A = Item # cross-referencing balloon numbers in the Pendulum Robot CAD drawing (RTV_Robot_1_Final_CAD_Assembly). Column B = Item # cross-referencing balloon numbers in the Ball-on-Beam Robot CAD drawing (RTV_Robot_2_Final_CAD_Assembly). A dash (—) means the part is not used in that robot. Parts with quantities in both columns are shared components. Section 1 shows estimated print material costs for reference — these are NOT included in the grand total.

Pendulum Robot Item #	Ball-on-Beam Robot Item #	Part Name (Material)	Make / Buy	Vendor & Purchase Link	Pendulum Robot QTY	Ball-on-Beam QTY	Pack Unit / Est. Weight	Pack Cost / Mat. Cost*	Cost / Piece or / Gram*	Total Cost Pendulum Robot	Total Cost Ball-on-Beam
SECTION 1 — Custom 3D Printed & Fabricated Parts (Make) * Columns I-L show estimated print material cost (grams × \$/g) for reference only — NOT included in grand total											
<i>↳ RTV Pendulum Robot — 3D Printed Parts Ref: RTV_Robot_1_Final_CAD_Assembly</i>											
1	—	Frame Base (PLA)	Make	3D Printed In-House	1	—	~200g (PLA @ \$17.99/kg)	\$3.60	\$3.598	\$3.60	\$0.00
2	—	Frame Top (PLA)	Make	3D Printed In-House	1	—	~160g (PLA @ \$17.99/kg)	\$2.88	\$2.878	\$2.88	\$0.00
3	—	Magnetic Potentiometer Mount (PLA)	Make	3D Printed In-House	1	—	~30g (PLA @ \$17.99/kg)	\$0.54	\$0.540	\$0.54	\$0.00
4	—	Yahboom Motor Bracket (PLA)	Make	3D Printed In-House	4	—	~15g ea (PLA @ \$17.99/kg)	\$0.27	\$0.270	\$1.08	\$0.00
16	—	Pendulum Shell (TPU)	Make	3D Printed In-House	1	—	~100g (TPU @ \$22.99/kg — est.)	\$2.30	\$2.299	\$2.30	\$0.00
<i>↳ Pendulum Arm Sub-Assembly — R1 Item #7 Ref: RTV_Pendulum_Arm_Final_Sub_Assembly</i>											
7-1	—	Pendulum Interior Bracket (PLA)	Make	3D Printed In-House	1	—	~50g (PLA @ \$17.99/kg)	\$0.90	\$0.900	\$0.90	\$0.00
7-4	—	Pendulum Shoulder Bracket / Elbow (PLA)	Make	3D Printed In-House	2	—	~50g ea (PLA @ \$17.99/kg)	\$0.90	\$0.900	\$1.80	\$0.00
7-5	—	Pendulum Arm Side Beam (Aluminum 6061, Ø6×82.5mm)	Make	Cut from Aluminum Rod Stock (see Section 2)	2	—	82.5mm × Ø6mm cut	\$0.00	\$0.000	\$0.00	\$0.00
7-3	—	Pendulum Long Interior Segment (Aluminum 6061, Ø4.67×53.3mm)	Make	Cut from Aluminum Rod Stock (see Section 2)	1	—	53.3mm × Ø4.67mm cut	\$0.00	\$0.000	\$0.00	\$0.00
7-2	—	Pendulum Small Inner Segment (Aluminum 6061, Ø4.67×37mm)	Make	Cut from Aluminum Rod Stock (see Section 2)	1	—	37mm × Ø4.67mm cut	\$0.00	\$0.000	\$0.00	\$0.00
19	—	Acrylic Window (Acrylic, 153.4×122×3.13mm)	Make	Cut from Acrylic Sheet (see Section 2)	1	—	153.4×122mm cut	\$0.00	\$0.000	\$0.00	\$0.00
<i>↳ RTV Ball-on-Beam Robot — 3D Printed Parts Ref: RTV_Robot_2_Final_CAD_Assembly</i>											
—	1	Center Hub (PLA)	Make	3D Printed In-House	—	1	~175g (PLA @ \$17.99/kg)	\$3.15	\$3.148	\$0.00	\$3.15
—	2	Motor Holder (PLA)	Make	3D Printed In-House	—	1	~140g (PLA @ \$17.99/kg)	\$2.52	\$2.519	\$0.00	\$2.52
—	3	Beam (PLA, 304.8mm)	Make	3D Printed In-House	—	1	~110g (PLA @ \$17.99/kg)	\$1.98	\$1.979	\$0.00	\$1.98
—	7	Shelf / Protoboard Shelf (PLA)	Make	3D Printed In-House	—	1	~55g (PLA @ \$17.99/kg)	\$0.99	\$0.989	\$0.00	\$0.99
—	8	Shaft Plug Key (PLA)	Make	3D Printed In-House	—	1	~15g (PLA @ \$17.99/kg)	\$0.27	\$0.270	\$0.00	\$0.27
—	19	Railroad / Bracket (PLA, 194.15mm)	Make	3D Printed In-House	—	2	~27.5g ea (PLA @ \$17.99/kg)	\$0.49	\$0.495	\$0.00	\$0.99
—	21	Center Hub Acrylic (Acrylic, 60.96×72.2×4.12mm)	Make	Cut from Acrylic Sheet (see Section 2)	—	2	60.96×72.2mm cut	\$0.00	\$0.000	\$0.00	\$0.00
—	22	Motor Hub Acrylic (Acrylic, 88.9×99.06×3.4mm)	Make	Cut from Acrylic Sheet (see Section 2)	—	2	88.9×99.06mm cut	\$0.00	\$0.000	\$0.00	\$0.00
SECTION 1 — Estimated Print Material Cost (Reference Only — NOT included in grand total below)										\$13.09	\$9.89

SECTION 2 — Mechanical & Structural Components (Buy)											
5, 8	—	520 DC Motors w/ Wheels & Brackets (GM3865-520)	Buy	Amazon — Yahboom	4	—	4-pack	\$31.56	\$7.890	\$31.56	\$0.00
—	4	Nema 17 Stepper Motor	Buy	Amazon	—	1	1 (each)	\$14.99	\$14.990	\$0.00	\$14.99
10	—	606-2RS Deep Groove Bearings (6mm bore)	Buy	Amazon — ucell	2	—	1 (each)	\$0.85	\$0.850	\$1.70	\$0.00
—	5	686-2RS Ball Bearings	Buy	Amazon — ucell	—	1	10-pack	\$8.59	\$0.859	\$0.00	\$0.86
—	—	Acrylic Sheets 4"×6" (raw stock for Cut parts in Section 1)	Buy	Amazon — KATELA	1	1	~10-sheet pack	\$16.99	\$1.699	\$1.70	\$1.70
7, 5-7, 2	—	Aluminum 6061 Round Rod (1/4"×13", raw stock for Pendulum Arm sub-parts)	Buy	Amazon	3	—	10-pack	\$11.99	\$1.199	\$3.60	\$0.00
6	6	LiFePO4 Batteries (3.2V 32700)	Buy	Amazon — CITYORK	4	4	4-pack	\$38.97	\$9.743	\$38.97	\$38.97

SECTION 3 — Fasteners & Hardware (Buy)											
9	—	Longer M3 Threaded Inserts (M3×5.7) — R1: 19 pcs R2: 12 pcs	Buy	Amazon — Ruthex	19	12	50-pack	\$9.99	\$0.200	\$3.80	\$2.40
12	—	Shorter M3 Threaded Inserts (M3×4.0) — R1: 12 pcs R2: 2 pcs	Buy	Amazon — Ruthex	12	2	50-pack	\$9.99	\$0.200	\$2.40	\$0.40
—	—	M2 Threaded Inserts — R2: 4 pcs	Buy	Amazon — Ruthex	—	4	50-pack	\$9.99	\$0.200	\$0.00	\$0.80
15	10	M3 × 8mm Socket Head Cap Screws — R1: 47 pcs R2 item #10: 6 pcs	Buy	Digital Machinery Inc.	47	6	100-pack	\$8.95	\$0.090	\$4.21	\$0.54
—	20	M3 × 12mm Socket Head Cap Screws — R2 item #20: 8 pcs	Buy	Digital Machinery Inc.	—	8	100-pack	\$8.95	\$0.090	\$0.00	\$0.72
—	18	M2 Screw Assortment — R2 item #18: 4×M2×8mm pcs	Buy	Amazon	—	4	200-pc asst.	\$14.99	\$0.075	\$0.00	\$0.30
—	12	M3 Zinc Hex Nuts — R2 item #12: 2 pcs	Buy	Home Depot — Everbilt	—	2	5-pack	\$3.75	\$0.750	\$0.00	\$1.50

SECTION 4 — Electrical & Electronics (Buy)											
—	16	Stepper Motor Driver (TMC2208)	Buy	Amazon — TMC2208	—	1	1 (each)	\$17.99	\$17.990	\$0.00	\$17.99
19	—	Motor Driver (DRV8871) — Pendulum Robot only	Buy	Amazon / DigiKey	2	—	1 (each)	\$4.33	\$4.330	\$8.66	\$0.00
11	—	AS5600 Magnetic Encoder — Pendulum Robot only	Buy	Amazon — UMLIFE	1	—	1 (each)	\$2.60	\$2.600	\$2.60	\$0.00
—	11	ToF Distance Sensor (VL53L0X) — Ball-on-Beam only	Buy	Amazon — Goroos	—	1	1 (each)	\$12.99	\$12.990	\$0.00	\$12.99
—	—	Voltage Step-Down / Buck Converter	Buy	Amazon — Euogeudel	1	1	1 (each)	\$8.69	\$8.690	\$8.69	\$8.69
17	13	BMS Board (4S 30A, 14.8V)	Buy	Amazon	1	1	1 (each)	\$8.99	\$8.990	\$8.99	\$8.99
18	15	Microcontroller (RP2040 / Pi Pico)	Buy	Amazon / Adafruit	1	1	1 (each)	\$12.99	\$12.990	\$12.99	\$12.99
—	—	LiFePO4 Battery Charger (14.6V)	Buy	Amazon	1	1	1 (each)	\$14.59	\$14.590	\$14.59	\$14.59
—	14	Protoboard / Solderable Breadboard	Buy	Amazon — EPLZON	1	1	1 (each)	\$14.59	\$14.590	\$14.59	\$14.59
14	9	Rocker Switch (On/Off)	Buy	Amazon — DaierTek KCD1	1	1	1 (each)	\$7.99	\$7.990	\$7.99	\$7.99
—	—	Dupont Jumper Wire Set (120-piece)	Buy	Amazon — Elegoo	1	1	120-pc set	\$6.98	\$6.980	\$6.98	\$6.98
—	—	Header Pins (40-pin strip)	Buy	Amazon — Honbay	1	1	40-pc strip	\$7.39	\$7.390	\$7.39	\$7.39
—	—	DIP Socket Kit — Pendulum Robot only	Buy	Amazon — CHIPNEW	1	—	1 (kit)	\$9.99	\$9.990	\$9.99	\$0.00
—	—	22 AWG Hookup Wire — Ball-on-Beam only	Buy	Amazon — TUOFENG	—	1	1 roll	\$15.29	\$15.290	\$0.00	\$15.29

SECTION 5 — UI Components (Buy)											
13	17	LCD Capacitive Touchscreen (4-inch, 320×480)	Buy	Amazon — Hosyond	1	1	1 (each)	\$20.99	\$20.990	\$20.99	\$20.99

SECTION 6 — Bulk Materials (Reference Only — Do Not Include in Per-Unit Cost Total) PLA: \$17.99/kg · TPU: \$22.99/kg (est. — verify on Elegoo store)											
—	—	PLA Filament (R1: ~600g used R2: ~550g used 1 roll covers each robot with surplus)	Buy	R1: Amazon — Overture R2: Creality Hyper PLA	1	1	1 kg roll (1,000g)	\$17.99	\$17.990	\$10.79	\$9.00
—	—	TPU Filament (R1: ~100g used — Pendulum Shell only est. price — verify on Elegoo store)	Buy	Elegoo — Rapid TPU Filament 1.75mm	1	—	1 kg roll (1,000g)	\$22.99	\$22.990	\$2.30	\$0.00

GRAND TOTAL — PURCHASED COST PER UNIT (Sections 2–5 only Section 1 print material costs shown separately above)										\$246.46	\$242.62
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LEGEND & NOTES

Make (Section 1): Parts designed and produced in-house by the team. Columns I–L show estimated filament material cost calculated as: grams used × (filament price + 1,000g). This cost is NOT included in the grand total — it is shown for transparency. Aluminum and acrylic cut parts show \$0.00 here because their raw material cost is already captured in Section 2.

Buy (Sections 2–5): Parts purchased from an external vendor. Cost Per Piece = Pack Cost + Pack Size. Total = Cost Per Piece × Quantity per robot.

Section 6 — Bulk Materials: PLA and TPU filament are listed for procurement reference only. R1 uses ~600g PLA + ~100g TPU. R2 uses ~550g PLA. One 1kg roll covers each robot with surplus. TPU pack cost is an estimate — verify current price at the Elegoo store link.

* Column headers 'Pack Cost / Mat. Cost' and 'Cost/Piece or /Gram' serve dual purpose: for Buy rows they show purchasing data; for Make rows (Section 1) they show print material cost data.