

One base. Many characters.

Prototype bill of materials

100 x 50 mm maximum footprint | Two drive wheels + passive caster

Revision: v0.1 Price check: 2026-09-29 Currency: USD

BUDGET VIEW	USD
Priced required hardware, excluding two motors	\$93.93
Custom fabrication and completion allowances	\$34.00
Planning subtotal, excluding two motors	\$127.93 + motors TBD
Optional distance sensor	\$14.95
Planning subtotal including sensor, excluding motors	\$142.88 + motors TBD

What this document establishes

A consistent set of component envelopes for the first CAD assembly, supplier links and a transparent prototype budget. The common base carries locomotion, battery, controller and audio amplifier. The removable body carries the display, speaker, microphone and two arm servos.

Two decisions remain on hold

Motor supply: Pololu #1124 is the dimensional reference, but the manufacturer marks it discontinued / special order. No reliable current stock or price was confirmed. Its cost is deliberately left TBD. The CAD motor mounts are provisional.

Power validation: the 1200 mAh battery fits the packaging study; simultaneous motor and servo current has not been validated. This is not an electrically qualified shopping list.

Prices are single-unit list prices, not checkout quotes. Shipping, taxes, duties, PCB work, tools, labor, firmware and a finished character body are excluded. No purchases made. Wiring is intentionally deferred.

01 / Common base BOM

Product names are clickable supplier links. A blank motor price is an unresolved sourcing item, not a zero-cost part.

ID	PART / SUPPLIER REFERENCE	QTY	UNIT	EXT.
B01	120:1 right-angle DC gearmotor Pololu / PCX 1124	2	TBD	TBD
B02	3/8-inch plastic ball caster Pololu 950	1	\$2.95	\$2.95
B03	XIAO ESP32-S3 Plus Seeed Studio 102010671	1	\$7.99	\$7.99
B04	DRV8833 dual motor driver carrier Pololu 2130	1	\$10.95	\$10.95
B05	LSM6DS3TR-C 6-axis IMU breakout Adafruit 4503	1	\$9.95	\$9.95
B06	Protected 1S 3.7 V 1200 mAh LiPo Adafruit 258	1	\$9.95	\$9.95
B07	USB-C single-cell LiPo charger Adafruit 4410	1	\$5.95	\$5.95
B08	5 V boost regulator U3V40F5 Pololu 4012	1	\$9.95	\$9.95
B09	MAX98357A I2S mono amplifier Adafruit 3006	1	\$5.95	\$5.95

Base assembly provisions

The CAD uses two motors mounted on their sides to keep the output axes horizontal and share one axle line. Custom narrow wheels are needed to preserve the 50 mm overall width. Commercial 32 x 7 mm wheels are a reference, not assumed to fit this arrangement.

The battery sits on a removable tray above the drivetrain. Electronics use adjustable mounting provisions rather than exact component pockets. USB-C access, connector projections and the antenna region must be checked on the selected physical boards.

02 / Body, option and custom parts

ID	PART / SUPPLIER REFERENCE	QTY	UNIT	EXT.
U04	Mini oval speaker, 8 ohm / 1 W Adafruit 3923	1	\$1.95	\$1.95
U01	1.3-inch 240 x 240 IPS LCD / ST7789 Waveshare 15867	1	\$9.49	\$9.49
U02	SG92R positional micro servo TowerPro / Adafruit 169	2	\$5.95	\$11.90
U03	SPH0645LM4H I2S MEMS microphone Adafruit 3421	1	\$6.95	\$6.95

Optional sensing - included as a CAD placeholder

ID	PART / SUPPLIER REFERENCE	QTY	UNIT	EXT.
O01	VL53L0X distance sensor breakout Adafruit 3317	1	\$14.95	\$14.95

Custom items and unselected electrical hardware

ID	ITEM / BASIS	BUDGET
M01	Custom wheel hubs + compliant TPU tread, pair Project estimate; 36 mm diameter x 4 mm tread width, recessed 3 mm D-bore hub. Prototype grip and hub fit untested.	\$4.00
M02	Printed shells, trays and body adapter Project material / print allowance, not a service quote. Excludes cosmetic body and printer purchase.	\$12.00
M03	Fasteners, inserts, straps and soft battery padding Project allowance; exact lengths/count depend on final CAD assembly. Caster hardware already included in B02.	\$8.00
E01	Power switch, fuse/protection, passives and connector allowance Provisional budget only. Rated switch / interlock, bulk capacitors and board connections await electrical design. No wiring or PCB design supplied.	\$10.00

Allowances are our planning estimates, not supplier prices. They cover one prototype set; failed prints, spare components and commercial print-service charges may increase cost. Mechanical fastener quantities and electrical accessory SKUs are not frozen.

03 / Packaging dimensions

All dimensions in mm. Published size describes the component; the CAD reserve is an engineering allowance where height or variant detail is missing. A reserve does not establish fit of leads, plugs, horns, airflow or service access.

ID	PUBLISHED SIZE / REFERENCE	CAD RESERVE
B01	54.5 length; 13.8 thickness; 24.8 max transverse; 9.7 exposed shaft	54.5 x 13.8 x 24.8, plus shaft
B02	19.1 x 12.1 x 10.1	19.1 x 12.1 x 10.1
B03	21 x 17.8; height not established	21 x 17.8 x 6
B04	20.3 x 15.2 PCB	20.3 x 15.2 x 5
B05	25.3 x 17.8 x 4.6	25.3 x 17.8 x 4.6
B06	62 x 34 x 5	62 x 34 x 5 nominal, clearance separate
B07	24 x 19 x 7.2	24 x 19 x 7.2
B08	15.2 x 15.2 x 5.6	15.2 x 15.2 x 5.6
B09	19.4 x 17.8 x 3 stated; terminal block taller	19.4 x 17.8 x 10
U04	30 x 20 x 5	30 x 20 x 5
U01	45 x 31 PCB; 23.4 x 23.4 active area	45 x 31 x 6
U02	23 x 11 x 29 product listing	24 x 13 x 30 body; ears / horn extra
U03	16.7 x 12.7 x 1.8	16.7 x 12.7 x 3
O01	21 x 18 x 2.8	21 x 18 x 4

Dimension confidence

High: motor and caster have manufacturer dimension drawings; most listed breakout boards publish external dimensions. **Provisional:** controller/display heights, servo variant envelope, amplifier terminal height and custom wheels. These are bounding-volume placeholders, not detailed supplier solids.

Motor drawing: [Pololu OJ822 - orientation and exposed shaft](#)

Caster drawing: [Pololu OJ1636 - housing, height and screw pitch](#)

04 / Integration decisions before purchase

Power architecture - candidate only

Use the protected 1S pack for the motor driver and a separate regulated 5 V rail for the servos and suitable logic inputs. The Micro-Lipo board charges the pack with the robot OFF. Its use must be interlocked or physically disconnected during operation; it is not a power-path controller. Avoid connecting two chargers to the cell.

The pack listing limits its leads to 2 A; its linked cell sheet states 2.4 A continuous. Two #1124 motors alone can approach 1.6 A at stall at 4.5 V. Servo peaks and boost conversion add load, so test peak current, set current limits and select a higher-discharge pack if needed. The 5 V regulator rating does not remove the battery limit. Use 500 mA charging per the pack supplier recommendation. [B01, B06-B08]

Battery technical source: [E503562 / 1200 mAh cell specification](#)

Controller pin budget - feasible direction, assignment pending

FUNCTION	SIGNALS TO RESERVE
Two DC motors	4 PWM/direction signals; sleep/fault may need more
Face display	SPI clock + data + CS + DC, plus reset/backlight strategy
IMU + optional ToF	2 shared I2C signals; interrupts optional
Microphone + amplifier	Potentially 4 I2S signals if compatible shared clocks are proven
Two arm servos	2 PWM signals

The minimum illustrated allocation is about 16 GPIO before independent display reset/backlight, driver fault, power controls and debugging. XIAO Plus extra pads can help, but the final pin map and peripheral timing must be proven. A small carrier PCB is a likely next step, not included in this BOM.

Mechanical release checks

Confirm motor supply and actual shaft length first. Measure servo ears/horns, wheel fit and board connectors. Weigh the complete base and upper body; prove its centre of mass stays inside the three-contact support triangle during motion. Validate caster rolling, wheel clearance and motor temperatures before freezing the cosmetic shell.

Runtime is deliberately not promised. The pack contains about 4.44 Wh nominal; usable runtime depends on drive duty, arm load, display brightness, Wi-Fi and conversion loss.

05 / Reuse and sourcing alternatives

Otto: use its ecosystem as a reference

Otto Academy provides manuals and downloadable robot print files, including Otto Wheels, Humanoid, Ninja and Emotions. It is a useful source for assembly ideas and character mechanisms. We have not established that an Otto chassis, board or kit satisfies this 100 x 50 mm envelope.

[Otto Academy - manuals and 3D files](#)

[OttoDIYLib - official Arduino robot library](#)

Check each downloaded file and repository license before copying or distributing a remix. No Otto mechanical geometry is incorporated in this original packaging model. Its classic Arduino-oriented examples are not a tested drop-in firmware stack for this ESP32-S3 differential-drive base.

Integrated display module: promising alternative, not the baseline

Seeed lists a XIAO 1.14-inch IPS Display (ESP32S3) with IMU and microphone at **\$16.90** and **26 x 48 x 10.6 mm**. It could reduce separate boards and interconnects. It puts the main controller in the removable body, however, so a self-contained common base would need a different control split. Expansion pins, firmware and fit must be checked before substitution.

[Seeed official display-family announcement and specifications](#)

Motor alternatives require a packaging revision

A Pololu #2358 136:1 sub-micro planetary gearmotor is listed at **\$19.95 each** and roughly **6 mm diameter x 19 mm body length**. It can enable a narrow direct-drive layout, but its small plastic gearbox and shaft need a much lighter, tested load. It is not an interchangeable replacement for #1124.

[Pololu #2358 - sub-micro motor alternative](#)

[Pololu #1124 at DigiKey - zero stock / no backorders observed](#)

Next hardware freeze

Resolve an obtainable motor with a published drawing; test one motor/driver/battery/servo set under load; then update the CAD mount, electrical rail plan and this BOM together. The current model is suitable for reviewing architecture and part placement while those decisions remain open.

Companion files: `outputs/bom/robot_base_bom.json` and `robot_base_bom.csv` contain row-level prices, quantities, URLs, dimensions, availability and notes. The PDF and structured BOM were generated from the same data.