List of Components and Materials

The following tables enumerate the materials and procurement sources for the product. This distinction is necessitated by a €100 budgetary constraint imposed on the initial build. The prototype aims to validate the product's technical requirements in a cost-efficient manner.

The first section contains a detailed list of the components necessary for the construction of the prototype.

Name	Type	Supplier	Notes	Link	Price	Quantity	Total
ESP32 DevKit V1, ESP32-WROOM-32	Processor	Farnell	Dual core 240 MHz, integrated Wi-Fi + Bluetooth. Replaces separate Wi-Fi module.	New link	8.75 €	1	8.75 €
Light Sensor, BH1750 (GY-302)	Sensor	Botnoll	I2C digital lux sensor, 0–65535 lux, 3.3–5V. Better than LDR — no conversion needed.	New link	1.87 €	1	1.87 €
CO2 Sensor, MQ-135	Sensor	Aquario	Detects CO2, NH3, alcohol, benzene, smoke. 10–1000 ppm. Analog + digital output. Compatible 5V ESP32. Needs 20s warm-up.	New link	6.09 €	1	6.09 €
Air Humidity and Temp Sensor, DHT22 (AM2302)	Sensor	Botnoll	Humidity 0–100% RH (±2%) + temperature -40–80°C (±0.5°C). Single-wire digital output. 3.3–5V.	New link	6.96 €	1	6.96 €

Scent Sprayer, Ultrasonic atomiser 5V	Actuator	electronperdido.es	108–110 kHz, 5V USB. Switched via relay. Use with essential oil diluted in water.		7.00 €	1	7.00 €
Speaker + Amplifier, MAX98357A	Actuator	Aquario	I2S Class-D amp (2.7–5.5V), directly compatible with ESP32. No external DAC needed.	New link	11.38 €	1	11.38 €
Speaker + Amplifier, MAX98357A	Actuator	Amazon / Funduinoshop / AliExpress	I2S Class-D amp (2.7–5.5V), directly compatible with ESP32. No external DAC needed.	New link	11.38 €	1	11.38 €
Relay Module, 5V single-channel relay	Control	AliExpress / Amazon / BricoGeek	Controls power to the ultrasonic atomiser from ESP32 GPIO pin.	New link	4.60 €	1	4.60 €
Power Supply, 5V 2A USB adapter	Power	Amazon / AliExpress / Any local shop	Powers ESP32 + peripherals. USB power bank also works for portability.	New link	7.26 €	1	7.26 €

The following section examines the different materials being evaluated for the structural framework of our project, outlining their respective advantages and disadvantages.

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For the low-cost prototype, the cocoon would be built using accessible, affordable materials. The structure would be formed with fiberglass rods and a hula hoop equatorial ring, covered with white matte spandex fabric as the projection surface. Sound insulation would use low-density acoustic foam — the typical egg-crate or studio foam panels —

fixed to the interior with velcro. Ventilation would be handled by one or two small 5V PC fans, directly compatible with the ESP32 via relay. The cocoon entrance would use a rigid transparent PVC plastic curtain or a flexible plexiglass sheet as a door, allowing the child to be seen from outside while keeping the interior environment controlled. The main advantages of this approach are its very low cost, ease of assembly without specialist tools, and the ability to rapidly iterate and modify the design. The main disadvantages are its limited durability, lower structural rigidity, basic acoustic performance, and an overall finish that would not be suitable for a deployable clinical or commercial environment.

For the final product, all materials would be replaced with architectural and industrial-grade equivalents. The structure would become a precision-machined anodised aluminium geodesic frame with CNC-cut connectors. The membrane would be a high-frequency technical PVC skin with a matte projection finish and an antibacterial inner coating. Acoustic insulation would use high-density melamine foam or rock wool panels integrated directly into the cocoon shell. Ventilation would incorporate a miniaturised HVAC system with temperature control and a HEPA filter, fully managed by the ESP32. The entrance would feature a solid 4 mm polycarbonate door with aluminium hinges and a soft magnetic latch, allowing the child to open and close it effortlessly without assistance. The key advantages of this version are its structural robustness, professional finish, superior acoustic and thermal performance, hygienic materials suitable for repeated clinical use, and a lifespan of several decades. The main disadvantages are the significantly higher cost, longer lead times for custom components, and the need for specialist fabrication and installation.