The physical MoodFlix server was fully designed and engineered as a **compact edge-AI device**, capable of performing multimodal inference locally. This design transforms MoodFlix into an autonomous and portable LAN-based AI appliance.

1. Mechanical Design and 3D Enclosure

The enclosure was modeled in Fusion 360 as a **rectangular case with rounded corners**, optimized for internal component layout, airflow, and camera visibility.

Overall Dimensions

- Width: **150 mm**
- Height: **80 mm**
- Depth: **100 mm**

This form factor allows enough space for:

- a compute board (Jetson SBC or similar)
- internal wiring and battery compartment
- a front-facing camera module
- microphone and cooling zones

2. Functional Openings and Airflow

The enclosure contains several purpose-built structural elements:

Front Camera Window

- Placed centrally on the front face
- Large enough to provide an unobstructed field of view for facial capture

Microphone and Port Cutouts

- Small internal openings allow microphone placement
- Additional side or rear apertures allow access to USB / power ports if required

Ventilation System

- The **top panel includes elongated ventilation slots**
- The **front lower area contains a perforated grill**

These features ensure:

- passive cooling during continuous inference,
- heat dissipation without active fans,
- silent operation suitable for office or home environments.

3. Internal Component Mounting

Inside the case, **vertical mounting pillars** (visible on the CAD render) are used to secure:

- the compute module,
- additional PCB boards,
- cable routing paths.

This guarantees:

- stable assembly,
- vibration-free positioning,
- clear access for maintenance.

The case geometry also includes internal clearance for:

- camera cables,
- microphone wiring,
- battery cells and safety components.

4. Backup Power System Design

To avoid unexpected shutdowns, the server incorporates a **battery-based backup system** engineered during development.

Battery Configuration

- Type: **Li-ion 18650**
- Cells: **3 pieces**
- Arrangement: **1S3P**
- Rated cell capacity: **3000 mAh**
- Total nominal capacity: **9000 mAh (9 Ah)**

Energy Budget Calculation

Required runtime target: **≈ 2 hours**
Estimated load: **≈ 12 W**

Power requirement:

$$E_{need} = P \times t = 12\,W \times 2\,h = 24\,Wh$$

Energy per cell:

$$E_{cell} = 3.7\,V \times 3\,Ah = 11.1\,Wh$$

Taking DC-DC conversion efficiency (η ≈ 0.85):

$$N_{cells} = \frac{24}{11.1 \times 0.85} \approx 2.5$$

Therefore, the final pack uses **3 cells**, providing:

- **total nominal energy ≈ 33.3 Wh**
- **usable energy ≈ 28 Wh**
- **autonomous runtime ≈ 2.3 hours**

This confirms the model meets the target runtime and provides safe graceful shutdown if main power is disconnected.

The battery system includes:

- a **1S BMS board** for protection against overcharge, over-discharge, and short circuit,
- a **DC-DC boost converter** to stabilize output at **5V** for the compute module.

5. Internal Layout Optimization

The 3D case design ensures:

- dedicated camera field window,
- isolated internal space for the 18650 battery pack,
- safe routing channels for BMS wiring and step-up converter,
- vertical clearance for compute board heat dissipation,
- easy access for assembly and modular replacement.

The printed body can be manufactured using PLA, ABS or PETG.
ABS or PETG are preferred for better thermal resistance when running inference workloads.

6. Operational Benefits

The physical server provides:

- **full offline inference (no cloud needed)**
- **LAN-based communication using MFNP protocol**
- **local multimodal AI: face emotion + voice tone + environment**
- **logging and personalization through internal storage**
- **redundant power via integrated battery pack**

This makes the system reliable, portable, and secure, suitable for:

- home usage,
- office kiosks,

- exhibitions,
- workshops,
- interactive installations.