Project Plan: Heatmap System with ESP32 and AHT21

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1 Introduction

This document outlines the general plan for a temperature and humidity data collection system using 48 AHT21 sensors arranged in three vertical layers, grouped 4 per wall. The system will use ESP32 boards, cables, and 3D-printed enclosures, with sensors connected to a central PCB.

2 Required Components

Component	**Qty.**	**Unit Price (lei)**	**Total (lei)**	**Link / Product Code**
ESP32 DevKit	12	30.87	370.44	emag.ro
AHT21 temp/humidity sensor	48	8.84	424.32	ardushop.ro
Wires (4x2m/sensor) – 100m total	~100m	0.88	88.00	ardushop.ro
USB-C power cable (2m)	12	10.41	124.92	ardushop.ro
5V/1A wall adapter	12	6.31	75.72	emag.ro
Male-female connectors (Dupont)	2 sets	15.90	31.80	ardushop.ro
Custom PCBs	12	0.00	0.00	DIY
3D printed sensor enclosures	48	0.00	0.00	DIY printing
3D printed central units	12	0.00	0.00	DIY printing
Estimated Total			**1,115.20 lei**	

3 Clarifications / Personal Requirements

- Each node contains a custom PCB and an ESP32 board. Sensors are connected via specially designed connectors. Each node has a unique ID set in firmware.
- The central unit is designed to support additional I2C and GPIO lines, configurable in code. The number of active sensors can be adjusted dynamically, including via Wi-Fi.
- Each sensor has a 3D-printed case with two M3 12mm screw holes and is fixed using double-sided adhesive tape.
- Cable length per sensor is approximately 1–2 meters, depending on placement.
- The central PCB includes:
  - Shared power line (+3.3V and GND);
  - SDA/SCL ports grouped per sensor pair;
  - Male connectors on the PCB and female connectors at the end of sensor wires.
- The ESP32 remains accessible for reprogramming through an opening in the enclosure.

- The design is modular – sensors can be added or removed easily.
- Central units are mounted on the wall.
- To reduce cost, one node can handle more than 4 sensors.

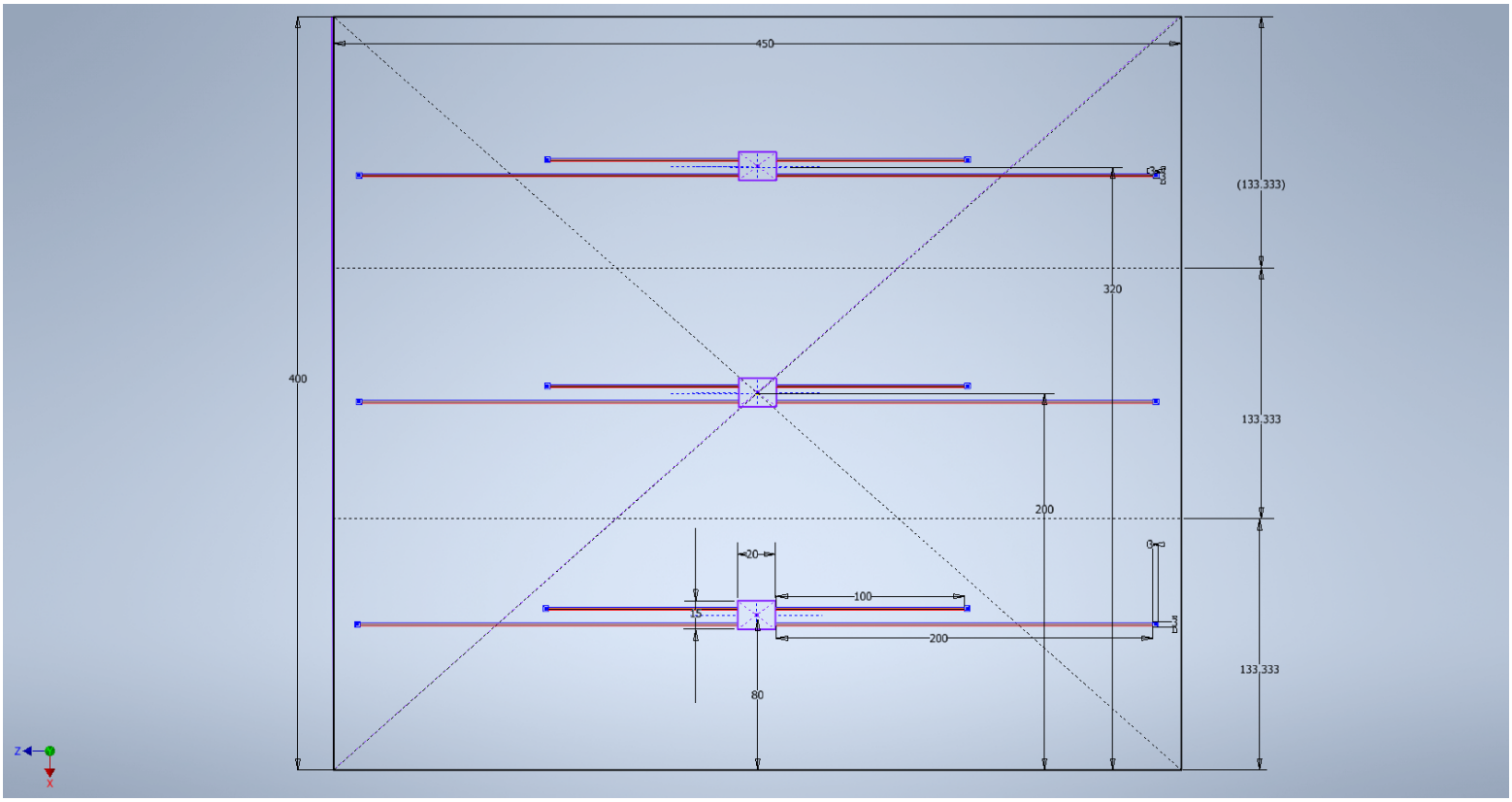
4 Remarks

- If I2C interference occurs, shielded cables can be used. For longer distances, dedicated modules such as I^2C extenders may help improve reliability. See: Hackaday – I^2C Over Long Wires.
- 3D-printed cable guides may be used to protect wires between sensors and their enclosures.
- Prices may vary slightly depending on suppliers, but the system remains scalable and adaptable.
- Sensor technical documentation (AHT21):
  AHT21 Datasheet – Aosong.

5 Sensor Wall Layout

This section includes a schematic showing how sensors are arranged on a single wall. It illustrates the physical layout: 4 sensors per layer in 3 vertical layers.

The lines labeled 100 and 200 represent wires that connect to sensors mounted in 3D-printed enclosures. In the center, the main box contains the ESP32 unit and a PCB. These units are arranged in sets of three at different heights on the wall. The layout is based on a wall size of approximately 450 cm in width and 400 cm in height.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