**1. Main Processing Unit**

**Raspberry Pi 4 Model B**

* **Specifications:**
  1. **CPU:** Quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz.
  2. **RAM Options:** 4GB or 8GB.
  3. **Connectivity:** Wi-Fi, Bluetooth 5.0, Ethernet.
  4. **USB Ports:** 2x USB 3.0, 2x USB 2.0.
  5. **Display Outputs:** 2x micro-HDMI (supports up to 4K).
  6. **GPIO Pins:** 40-pin header for hardware interfacing.

The Raspberry Pi 4 serves as the central processor for managing image processing and running the emotion detection algorithm. It provides high computational power while allowing seamless connectivity to other peripherals.

**2. Arduino Nano**

* **Specifications:**
  1. **Microcontroller:** ATmega328P (16MHz clock speed).
  2. **Operating Voltage:** 5V (logic level).
  3. **Input Voltage (Vin):** 7-12V.
  4. **Digital I/O Pins:** 14 (6 PWM outputs).
  5. **Analog Input Pins:** 8.
  6. **Flash Memory:** 32 KB (2 KB used by bootloader).

The Arduino Nano acts as a lightweight controller for interfacing sensors, handling simple tasks, and managing communication with the NRF24L01+ module.

**3. NRF24L01+ Wireless Module**

* **Specifications:**
  1. **Frequency Range:** 2.4GHz ISM band.
  2. **Data Rate:** Configurable up to 2 Mbps.
  3. **Operating Voltage:** 1.9V to 3.6V.
  4. **Communication Interface:** SPI (Serial Peripheral Interface).
  5. **Antenna Options:** PCB antenna or external antenna for extended range.
  6. **Range:** Up to 100 meters (line-of-sight with external antenna).

A low-power wireless transceiver module used for transmitting and receiving emotion detection results. It communicates with the Arduino Nano and provides reliable, long-range data transmission.

**4. Power Supply**

**12V 3A DC Power Adapter**

* **Specifications:**
  1. **Input Voltage:** 100-240V AC (50/60Hz).
  2. **Output Voltage:** 12V DC.
  3. **Output Current:** 3A (36W).
  4. **Connector Type:** Barrel jack (5.5mm x 2.1mm).
  5. **Cable Length:** Typically 1 meter.
* **Description:**  
  A reliable power source that provides a stable 12V DC supply for the system, ensuring all connected components operate efficiently.

**5. Buck Converter (Step-Down DC-DC Converter)**

* **Specifications:**
  1. **Input Voltage:** 12V DC (up to 24V supported).
  2. **Output Voltage:** 5V
  3. **Maximum Output Current:** 3A.
  4. **Efficiency:** ~95% (varies with load).
  5. **Form Factor:** Compact PCB module
  6. **Protections:** Overcurrent, overtemperature, and short-circuit.
* **Description:**  
  Converts 12V input to 5V for the Raspberry , ensuring efficient power distribution to all components.

**6. Camera Module – zebronics webcam**

Captures high-quality images for processing and emotion detection, compatible with the Raspberry Pi's USB port.

**7. Voltage Regulator**

**AMS1117 3.3V Voltage Regulator**

* **Specifications:**
  1. **Input Voltage:** 5V to 12V.
  2. **Output Voltage:** 3.3V (fixed).
  3. **Maximum Output Current:** 800mA.
  4. **Dropout Voltage:** 1.1V (typical).
  5. **Accuracy:** ±1%.
  6. **Package Type:** SOT-223 or TO-220.

Regulates the voltage from the buck converter to provide stable 3.3V power to the NRF24L01+ and other 3.3V components.