HARDWARE ARCHITECTURE

1.1 Hardware Architecture Explanation

The hardware architecture is divided into **two physical nodes**:

Smart Waste Bin Node (Edge Device)

Responsible for:

- Measuring bin fill level
- Local computation
- Wireless data transmission

Components Used

- Arduino UNO – sensor interfacing & edge processing
- HC-SR04 Ultrasonic Sensor – fill level detection
- SX1278 LoRa Module – long-range communication
- Battery supply (conceptual)

Gateway Node

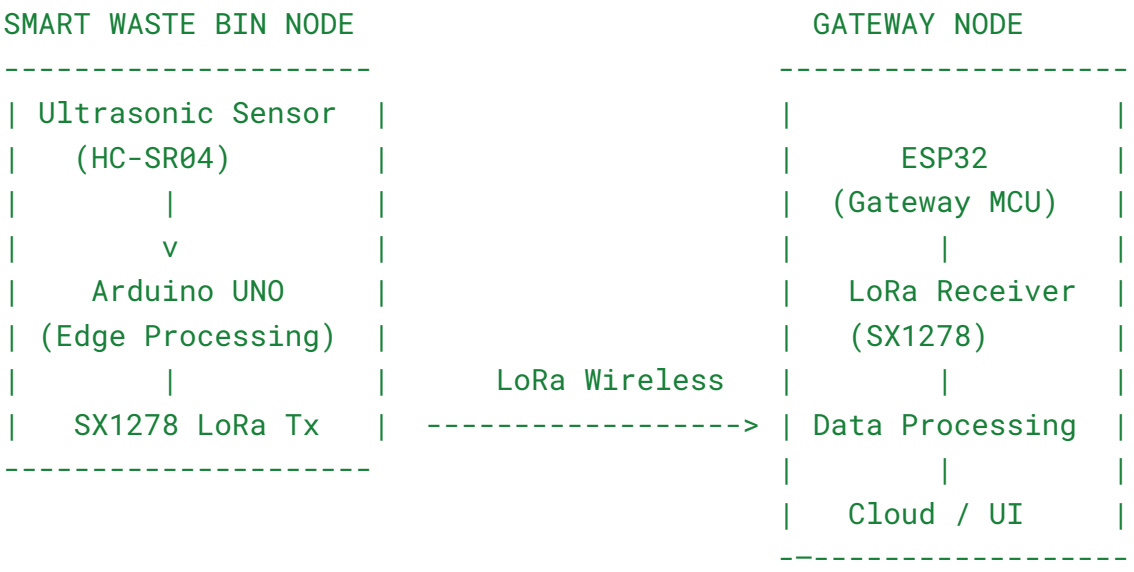
Responsible for:

- Receiving data from multiple bins
- Processing alerts
- Forwarding data to cloud/dashboard

Components Used

- ESP32 – gateway controller
- SX1278 LoRa Module – receiver
- Wi-Fi (conceptual cloud connection)

1.2 Hardware Block Diagram (Use this in report)



1.3 Pin Connections (Important for Evaluation)

Ultrasonic → Arduino UNO

HC-SR04	Arduino
VCC	5V
GND	GND
TRIG	D5
ECHO	D6

SX1278 → Arduino UNO (SPI)

SX1278	Arduino
VCC	3.3V
GND	GND
NSS	D10
MOSI	D11
MISO	D12
SCK	D13
DIO0	D2
RESET	D9

Never connect SX1278 to 5V

SX1278 → ESP32

SX1278	ESP32
VCC	3.3V
GND	GND
NSS	GPIO 18
MOSI	GPIO 23
MISO	GPIO 19
SCK	GPIO 5
DIO0	GPIO 26
RESET	GPIO 14