Walkie-Talkie Device Using Raspberry Pi 4B – Technical Documentation

1. Project Overview

This project implements a **Raspberry Pi-powered softphone** walkie-talkie system using VoIP (SIP-based communication) via **Linphone CLI**. A **single press** of a **push button** triggers an **API call**, which initiates the VoIP call. The communication is **full-duplex** — like a traditional phone call — not push-to-talk (PTT). The hardware design is compact and connected via a spiral cable for flexibility in vehicular or field use.

2. Hardware Components

Component	Description
Raspberry Pi 4 Model B	Main controller for SIP calling and GPIO handling
USB Sound Card	Provides audio input/output via 3.5mm AUX ports
PAM8403 Audio Amplifier	Amplifies speaker output from USB sound card
5W 3Ω Speaker	Outputs the voice from the other end
Microphone	Standard mic connected via 3.5mm jack to sound card
Push Button	Triggers API to initiate or end VoIP call
8-Core Spiral Cable	Connects all peripheral signals between Pi and handset

3. Functional Workflow

1. **Push Button Pressed**

   - Connected to GPIO17 (pull-up logic) and GND**.**

   - Detected via software using `gpio` library

   - Sends an HTTP POST request to the specified API endpoint.

2. **API Call**

    ○ Triggers server-side SIP call setup between two SIP endpoints.

3. **VoIP Call Starts**

    ○ Raspberry Pi launches Linphone CLI

    ○ Makes an outbound call to SIP URI (e.g., `sip:6674@sipserver.com`)

    ○ Enables full-duplex communication via USB sound card

4. Electrical Connections

Push Button

- Connected to **GPIO17** and **GND**

- Configured with **internal pull-up** in software

- Logic: **Pressed = LOW**, **Released = HIGH**

USB Sound Card

- Plugged into Pi's **USB port**

- **Input (mic)**: Connected to mic via 3.5mm jack

- **Output (audio)**: Connected to PAM8403 amp via 3.5mm jack

PAM8403 Amplifier

- **Input**: 3.5mm audio output from sound card (L/R + GND)

- **Power**: 5V and GND from Raspberry Pi (via spiral cable)

- **Output**: Drives 5W 3Ω speaker

5. Spiral Cable Wire Assignment (8-Core)

| Wire Pair	Purpose
4 wires	USB sound card (VCC, GND, D+, D-)
2 wires	Push button (GPIO17, GND)
2 wires	PAM8403 power (5V, GND)

6. Audio Configuration

- **Microphone** input via USB sound card (3.5mm)

- **Speaker** output amplified by PAM8403 (via 3.5mm jack)

- Default audio device is set to USB sound card in Linux (via `.asoundrc` or `alsamixer`)

7. Enclosure & Mounting

- **Walkie Talkie handset**: Push button, speaker, mic, amp, sound card inside compact housing

- **Junction box**: Intermediate connector for spiral cable

- **Main Unit Box (Gold Seat)**: Contains Raspberry Pi, Wi-Fi, power module

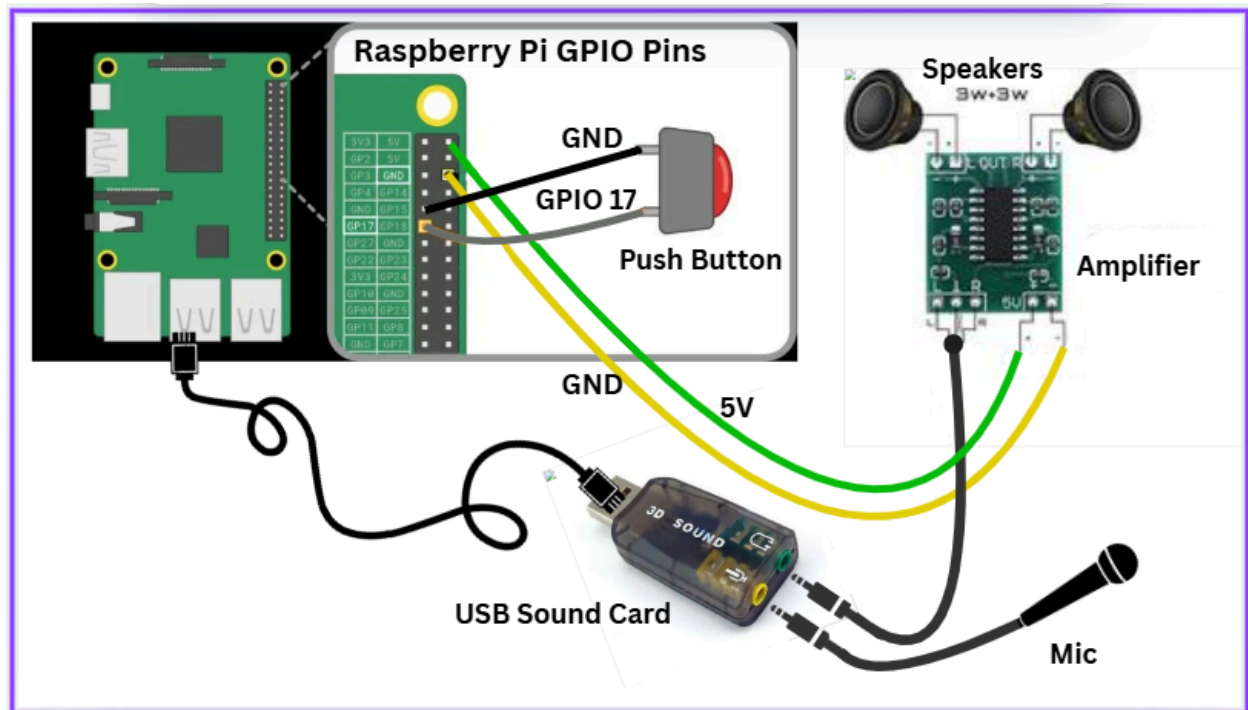- **Battery**: Powers entire system (12V input → 5V output for Pi)

8. System Flow Diagram
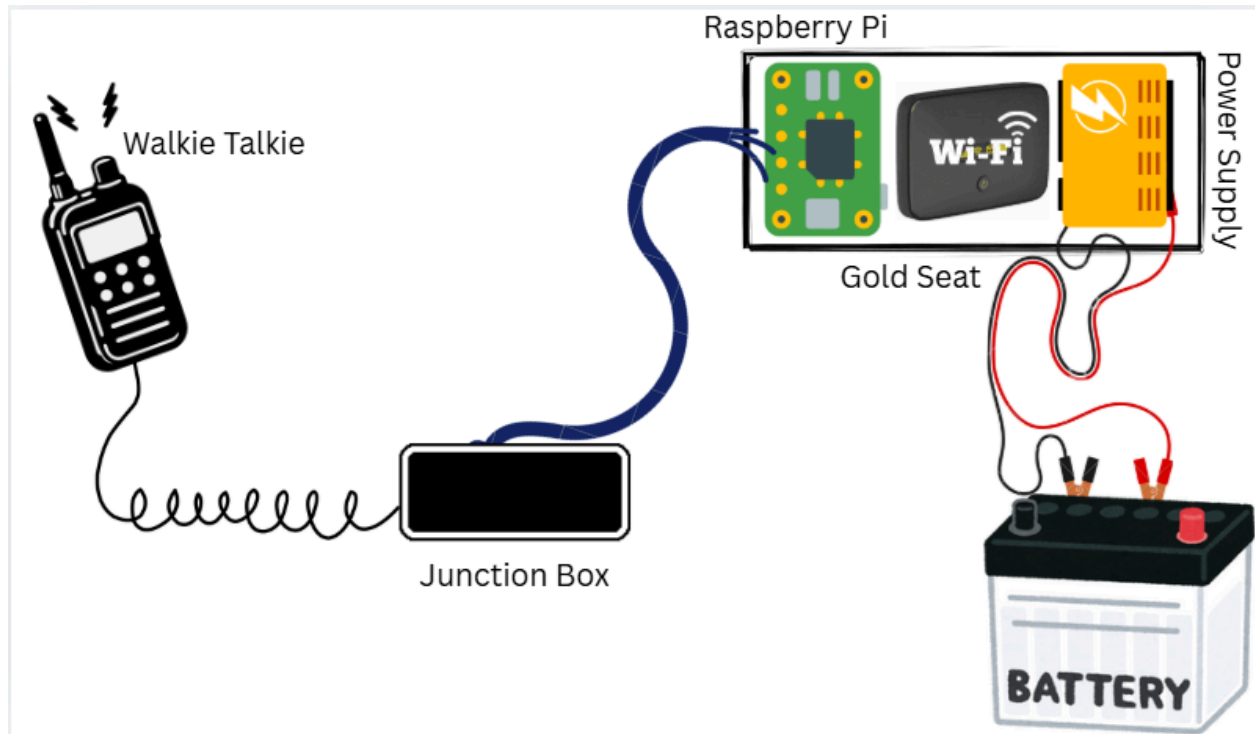
9. Schematic Circuit Diagram
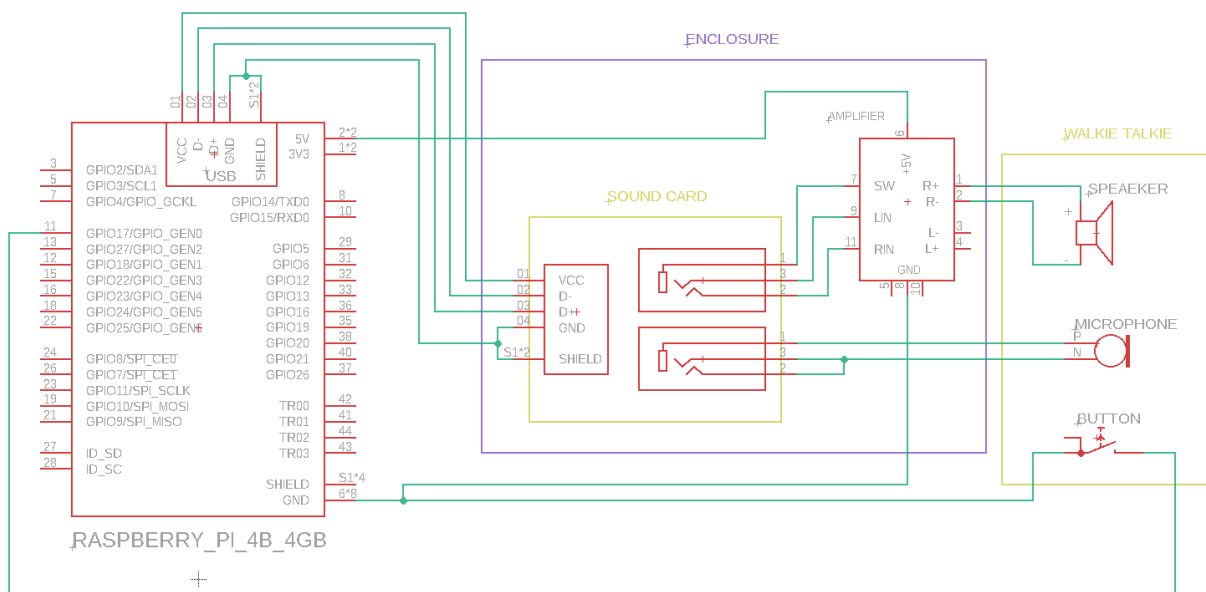
10. Physical Connection Diagram

11. Summary

This project successfully demonstrates a **button-triggered SIP call** system using Raspberry Pi that functions similarly to a smart walkie-talkie or mobile intercom. It integrates hardware (USB mic, amp, speaker) with software-based voice calling over SIP using Linphone.