P32 Goblin Full - Complete Visual Build Guide

What You're Building

A mood-driven animatronic goblin head with:

- **3 Animated Displays** (2 eyes + 1 mouth)
- **Distance Sensing** (proximity detection)
- **Audio Output** (sounds and speech)
- **9 Emotional States** (automatic mood changes)

Complete Wiring Diagram

Complete Wiring Diagram

GPIO Pin Assignments Quick Reference

GPIO	Component	Function	Wire Color
4	Audio Amp	I2S BCLK	Red
5	Audio Amp	I2S WS	Black
6	Audio Amp	I2S DATA	White
9	HC-SR04	TRIG	Gray
10	HC-SR04	ECHO	Pink
12	All Displays	SPI MISO	Blue
13	All Displays	SPI MOSI	Green
14	All Displays	SPI CLK	Yellow
15	Left Eye	CS	Orange
16	Right Eye	CS	Purple
17	Mouth	CS	Brown

Power Distribution System

```
Power Rail Architecture:

5V Supply ─┬─ ESP32 VIN
           ├─ All Display VCC pins
           ├─ Audio Amp VCC
           └─ Sensor VCC

Ground ────┬─ ESP32 GND
           ├─ All Display GND pins
           ├─ Audio Amp GND
           └─ Sensor GND
```

Critical: All components share common 5V and Ground rails

Assembly Order (Follow This Sequence!)

1 Power Setup First

```
Breadboard Setup:
┌─────────────────────────────────┐
│ Red Rail    [+5V from supply] ●●●●● │
│                                 │
│ Main Area   [Components here]   │
│                                 │
│ Black Rail  [GND from supply] ●●●●● │
└─────────────────────────────────┘
```

2 ESP32 Connection

- VIN → Red power rail
- GND → Black power rail
- **Test:** Verify 5V with multimeter before proceeding

3 SPI Bus Wiring (Shared Lines)

```
ESP32 Shared SPI Bus:
    GPIO 12 (MISO) ──┬──┬──┬── All displays SDO
    GPIO 13 (MOSI) ──┼──┼──┼── All displays SDA
    GPIO 14 (CLK)  ──┼──┼──┼── All displays SCL
                     │  │  │
                  Left│ Right│ Mouth
                   Eye│  Eye │ Display
```

4 Individual Chip Selects

- GPIO 15 → Left eye CS (Orange wire)
- GPIO 16 → Right eye CS (Purple wire)

- GPIO 17 → Mouth CS (Brown wire)

5️⃣ Audio System

```
I2S Digital Audio:
    ESP32 GPIO 4 ——— MAX98357A BCLK
    ESP32 GPIO 5 ——— MAX98357A LRCK
    ESP32 GPIO 6 ——— MAX98357A DIN

    MAX98357A + ——— Speaker +
    MAX98357A - ——— Speaker -
```

6️⃣ Distance Sensor

```
HC-SR04 Connections:
    ESP32 GPIO 9  ——— TRIG pin
    ESP32 GPIO 10 ——— ECHO pin
    5V power rail ——— VCC pin
    Ground rail   ——— GND pin
```

🔧 Testing Checklist

Power Verification (Use Multimeter)

- [ ] 5V present on ESP32 VIN
- [ ] 5V present on all display VCC pins
- [ ] 5V present on audio amp VCC
- [ ] 5V present on sensor VCC
- [ ] Continuity on all GND connections

Software Upload

- [ ] PlatformIO project opens without errors
- [ ] `ENABLE_GOBLIN_COMPONENTS` defined in config
- [ ] Build completes (~5.8% RAM, ~51.7% Flash)
- [ ] Upload successful to COM port
- [ ] Serial monitor shows loop messages

Component Function Tests

- [ ] All 3 displays show content
- [ ] Eye displays animate (blink cycle)
- [ ] Mouth display changes colors
- [ ] Speaker produces clear audio
- [ ] Distance sensor readings change with proximity
- [ ] Mood system cycles through emotions

🎭 Mood System Overview

Your goblin automatically cycles through 9 emotions:

Emotion	Visual Effect	Trigger Condition
😨 **FEAR**	Pale colors, rapid blinks	Sudden proximity
😠 **ANGER**	Red colors, intense stare	Sustained proximity
😤 **IRRITATION**	Orange tints, narrow eyes	Repeated interaction
😊 **HAPPINESS**	Bright colors, wide eyes	Positive interaction
😌 **CONTENTMENT**	Soft blue, relaxed	Extended calm period
🍽️ **HUNGER**	Green tints, searching	Time-based cycle
🤔 **CURIOSITY**	Blue tints, alert look	Motion detection
💕 **AFFECTION**	Pink tints, gentle gaze	Gentle interaction
🤩 **EXCITEMENT**	Rapid color changes	High activity

🚨 Troubleshooting Guide

No Display Output

Symptoms: Black screens on all displays
Check:

- 5V power on display VCC pins
- SPI wiring (GPIO 12,13,14 connections)
- Individual CS pin connections (GPIO 15,16,17)

Build/Upload Errors

Symptoms: Compilation fails
Check:

- `p32_component_config.h` contains `#define ENABLE_GOBLIN_COMPONENTS`
- USB-C cable connected to ESP32
- Correct COM port detected

No Audio

Symptoms: Silent speaker
Check:

- I2S connections (GPIO 4,5,6)
- 5V power to audio amplifier
- Speaker polarity (+ and - terminals)

Sensor Not Working

Symptoms: Fixed distance readings
Check:

- HC-SR04 requires full 5V (not 3.3V)
- GPIO 9,10 connections
- No obstructions in front of sensor

🔧 Component Specifications

ESP32-S3-DevKitC-1

- **MCU:** Dual-core 240MHz
- **RAM:** 512KB SRAM
- **Flash:** 8MB
- **WiFi/Bluetooth:** Built-in
- **GPIO:** 45 pins (11 used, 34+ available)

GC9A01 Round Displays (×3)

- **Size:** 1.28" diameter
- **Resolution:** 240×240 pixels
- **Interface:** SPI (7-pin)
- **Colors:** 65,536 (RGB565)
- **Voltage:** 3.3V logic, 5V power

MAX98357A Audio Amplifier

- **Interface:** I2S digital input
- **Output:** 3W @ 4Ω
- **SNR:** 92dB
- **Voltage:** 5V power

HC-SR04 Distance Sensor

- **Range:** 2cm to 400cm
- **Accuracy:** ±3mm
- **Interface:** Digital trigger/echo
- **Voltage:** 5V required

🚀 Expansion Ideas

With 34+ unused GPIO pins, add:

- **Servo neck movement** (PWM control)
- **LED accent lighting** (WS2812B strips)
- **Camera module** (ESP32-CAM integration)
- **Microphone input** (I2S or ADC)
- **Wheeled mobility base** (motor controllers)
- **Additional displays** (expand face features)

📞 Support Resources

- **GitHub Repository:** p32-animatronic-bot (https://github.com/reussered/p32-animatronic-bot)
- **Documentation:** See `/docs` folder for technical specs
- **Hardware Datasheets:** Component manufacturer websites
- **ESP32 Resources:** Espressif official documentation

🎉 **Congratulations! You've built a complete mood-driven animatronic system!**

Print this guide in color for best results. The SVG diagram will scale perfectly on any printer.