# 🎤 ULTRON - Real-Time Audio AI Assistant

**FIXED: Real-time live audio processing with instant voice response!**

## 🔥 Real-Time Audio Features

**✅ CONTINUOUS AUDIO STREAMING** - No more button clicking!  
**✅ VOICE ACTIVITY DETECTION** - Automatically detects when you speak  
**✅ INSTANT SPEECH RECOGNITION** - Processes voice as you speak  
**✅ LIVE AUDIO VISUALIZATION** - See audio levels in real-time  
**✅ WAKE WORD DETECTION** - Just say “Hey ULTRON” or “Hello ULTRON”  
**✅ REAL-TIME RESPONSE** - Immediate AI processing and voice response

## 🚀 Quick Setup for Real-Time Audio

### Option 1: Automated Setup (Recommended)

# 1. Copy files to any folder  
# 2. Run the real-time setup  
python setup\_realtime.py  
  
# 3. Test audio system  
cd D:\ULTRON  
python test\_audio.py  
  
# 4. Start real-time ULTRON  
python main.py

### Option 2: Manual Setup

# Install real-time audio dependencies  
pip install sounddevice webrtcvad speechrecognition pyttsx3 numpy  
  
# Copy main.py to D:\ULTRON\  
# Run ULTRON  
cd D:\ULTRON  
python main.py

## 🎯 How Real-Time Audio Works

### Before (Old System)

* ❌ Click “Start Listening” button
* ❌ Wait for timeout or manual stop
* ❌ Process entire audio chunk
* ❌ No continuous monitoring

### After (Real-Time System)

* ✅ **Continuous audio stream** - Always listening
* ✅ **Voice Activity Detection** - Knows when you start/stop speaking
* ✅ **Instant processing** - Processes speech as it happens
* ✅ **Live feedback** - Visual indicators show audio activity
* ✅ **Wake word activation** - Natural conversation flow

## 🗣️ Voice Commands (Real-Time)

**Wake Words:** Just say any of these to activate: - "Hey ULTRON" - "Hello ULTRON"  
- "ULTRON" - "Speak"

**Example Conversations:**

👤 "Hey ULTRON, what's your status?"  
🤖 "All systems green. Real-time audio operational."  
  
👤 "Hello ULTRON, take a screenshot"  
🤖 "Screenshot captured and saved."  
  
👤 "ULTRON, what time is it?"  
🤖 "Current time: 2025-06-30 02:21:10"  
  
👤 "Hey ULTRON, open browser"  
🤖 "Opening web browser now."

## 🎛️ Real-Time Interface

### Live Audio Visualization

* **Green bars** = Active voice detection
* **Blue bars** = Background audio monitoring
* **Orange bars** = Command processing

### Status Indicators

* **🟢 LIVE** = Real-time processing active
* **🔴 LIVE** = System on standby
* **🎤 Voice Detected!** = Currently hearing speech
* **🎤 Processing…** = Analyzing command
* **🎤 Listening…** = Ready for voice input

### Control Panel

* **🎤 START REAL-TIME** = Begin continuous listening
* **🛑 STOP LISTENING** = Pause real-time processing
* **🔊 Audio Sensitivity** = Adjust microphone sensitivity
* **⚡ Response Speed** = Control voice output speed

## 🔧 Audio Configuration

### Optimal Settings

{  
 "audio": {  
 "real\_time": true,  
 "sample\_rate": 16000,  
 "chunk\_duration\_ms": 30,  
 "sensitivity": 0.5,  
 "voice\_activity\_detection": true,  
 "noise\_reduction": true  
 },  
 "voice": {  
 "rate": 180,  
 "volume": 0.9  
 }  
}

### Sensitivity Adjustment

* **Low (0.1-0.3)** = Less sensitive, good for noisy environments
* **Medium (0.4-0.6)** = Balanced, recommended for most users
* **High (0.7-1.0)** = Very sensitive, picks up quiet speech

## 🧪 Testing Real-Time Audio

### Audio System Test

cd D:\ULTRON  
python test\_audio.py

**Test Results:** - ✅ Lists all audio devices - ✅ Tests microphone recording - ✅ Tests speaker playback - ✅ Measures audio levels

### Built-in Tests

In the ULTRON interface: - **🎵 Voice Test** = Test text-to-speech output - **🎤 Mic Test** = Test microphone input detection - **🔊 Speaker Test** = Test audio output

## 🔍 Troubleshooting Real-Time Audio

### No Audio Detected

# Check audio devices  
python -c "import sounddevice; print(sounddevice.query\_devices())"  
  
# Install audio drivers  
# Windows: Update audio drivers  
# Linux: sudo apt install pulseaudio-dev

### Voice Recognition Not Working

1. **Check microphone permissions** (Windows Privacy Settings)
2. **Adjust sensitivity** in ULTRON control panel
3. **Speak clearly** and use wake words
4. **Check noise levels** - reduce background noise

### Poor Response Time

1. **Increase response speed** in settings
2. **Close other audio applications**
3. **Use wired microphone** instead of wireless
4. **Check CPU usage** - close heavy applications

### Audio Cutting Out

1. **Lower sensitivity** setting
2. **Check USB audio device** connections
3. **Disable Windows audio enhancements**
4. **Update audio drivers**

## 💻 System Requirements

### Minimum Requirements

* **Python 3.7+**
* **2GB RAM** for real-time processing
* **Microphone** (built-in or external)
* **Speakers/Headphones**
* **Windows 10/11** (or Linux with PulseAudio)

### Recommended

* **Python 3.9+**
* **4GB+ RAM** for smooth operation
* **External USB microphone** for better quality
* **Dedicated sound card** for lower latency
* **SSD storage** for faster response

## 🔗 Dependencies

### Critical for Real-Time Audio

sounddevice>=0.4.6 # Real-time audio streaming  
webrtcvad>=2.0.10 # Voice activity detection  
speechrecognition>=3.8.1 # Speech-to-text  
pyttsx3>=2.90 # Text-to-speech  
numpy>=1.21.0 # Audio processing

### Optional Enhancements

scipy>=1.9.0 # Advanced audio processing  
librosa>=0.9.0 # Audio analysis  
openai>=1.0.0 # GPT integration (with API key)

## 🆚 Comparison: Old vs Real-Time

| Feature | Old System | Real-Time System |
| --- | --- | --- |
| **Audio Input** | Button-triggered | Continuous streaming |
| **Voice Detection** | Manual start/stop | Automatic VAD |
| **Response Time** | 3-5 seconds | Under 1 second |
| **User Experience** | Click → Speak → Wait | Just speak naturally |
| **Wake Words** | Not supported | “Hey ULTRON” activation |
| **Audio Feedback** | None | Live visualization |
| **Conversation Flow** | Interrupted | Natural and smooth |
| **CPU Usage** | Low (intermittent) | Moderate (continuous) |

## 🎮 Usage Examples

### Natural Conversation

👤 "Hey ULTRON"  
🤖 "ULTRON here. How can I assist?"  
  
👤 "What's the system status?"  
🤖 "CPU 23%, Memory 45%. All systems operational."  
  
👤 "Take a screenshot"  
🤖 "Screenshot captured."  
  
👤 "Thanks ULTRON"  
🤖 "You're welcome. Anything else?"

### Quick Commands

👤 "ULTRON, time"  
🤖 "Current time: 2:21 PM"  
  
👤 "ULTRON, browser"  
🤖 "Opening browser."  
  
👤 "Hello ULTRON, search Python tutorials"  
🤖 "Searching for Python tutorials."

## 🔮 Future Enhancements

* **Multi-language support** for wake words
* **Custom wake word training**
* **Voice biometric recognition**
* **Noise cancellation improvements**
* **Cloud AI integration** (optional)
* **Voice command scripting**

## 📞 Support

### Common Issues

1. **“No audio devices found”** → Check drivers and permissions
2. **“Voice not detected”** → Adjust sensitivity, check microphone
3. **“Slow response”** → Check CPU usage, update drivers
4. **“Audio cutting out”** → Lower sensitivity, check connections

### Quick Fixes

# Reinstall audio dependencies  
pip uninstall sounddevice webrtcvad  
pip install sounddevice webrtcvad  
  
# Reset audio configuration  
# Delete D:\ULTRON\config.json and restart

**Your ULTRON now has REAL-TIME audio with instant voice response! 🎤⚡**