Smart Wellness Desk Assistant Setup Guide

This guide provides a detailed, step-by-step procedure for setting up your smart wellness desk assistant project using the STM32 Nucleo-L476RG.

1. Components List

- **STM32 Nucleo-L476RG Board:** This is the microcontroller board that will act as the "brain" of your project.
- **Ultrasonic Sensor (Y401):** This sensor will detect the presence of a person at the desk. (Often, HC-SR04 is used, if Y401 is similar, the connections should be adaptable)
- **Temperature Sensor (HW220):** This sensor will measure the surrounding temperature. (Check if this is digital or analog. If digital, it might use I2C or other protocols. If analog, you'll use an ADC pin.)
- **1.3-inch OLED Display:** This display will show messages like "Waiting for user," "Moderate temperature," and "Too hot." (Check the communication protocol: I2C or SPI.)
- **Buzzer:** This will alert the user to take a break.
- **Jumper Wires:** To connect the components to the STM32 Nucleo board.
- **Breadboard (Optional but Recommended):** To make the connections easier and more organized.

2. Component Details and Considerations

- **STM32 Nucleo-L476RG:**
  - Make sure you have the necessary software development environment set up (e.g., STM32CubeIDE).
  - Familiarize yourself with the board's pinout diagram. You'll need to identify the correct pins for power, ground, and data communication.
- **Ultrasonic Sensor (Y401 or HC-SR04):**
  - These sensors typically have four pins:
    - VCC: Connect to 5V.
    - GND: Connect to Ground.
    - Trig (Trigger): Send a short pulse to initiate the measurement.
    - Echo: Receive the reflected pulse. The duration of this pulse determines the distance.
  - **Important:** The STM32 Nucleo-L476RG operates at 3.3V logic. If your ultrasonic sensor outputs 5V signals, you might need a voltage divider on the Echo pin to prevent damage to the STM32.
- **Temperature Sensor (HW220):**

    - **Crucial:** Determine if this sensor is analog or digital.
        - **Analog:** It will output a voltage proportional to the temperature. Connect it to an analog input pin (ADC) on the STM32.
        - **Digital:** It will communicate using a specific protocol (e.g., I2C, SPI, 1-Wire). You'll need to connect it to the corresponding pins on the STM32. If it is a 1-Wire sensor, like the DS18B20, you'll need to handle the 1-Wire protocol in your code.
- **1.3-inch OLED Display:**
    - OLED displays usually communicate via I2C or SPI.
    - Identify the communication protocol of your display.
    - **I2C:** Typically has pins for VCC, GND, SCL (Serial Clock), and SDA (Serial Data).
    - **SPI:** Typically has pins for VCC, GND, SCK (Serial Clock), MOSI (Master Out Slave In), and sometimes MISO (Master In Slave Out) and CS (Chip Select).
- **Buzzer:**
    - Connect the positive (+) pin of the buzzer to an STM32 pin that can output a signal.
    - Connect the negative (-) pin to GND.
    - You might need a current-limiting resistor (e.g., 100-220 ohms) in series with the buzzer to protect the STM32 pin, depending on the buzzer's specifications.

3. Wiring Diagram and Connections

Here's a generalized wiring diagram. **You MUST adapt this based on the specific pinouts of your sensors and OLED display.**

```
STM32 Nucleo-L476RG       Ultrasonic Sensor (HC-SR04 Example)
--------------------      ---------------------------------
5V ------------------------- VCC
GND ------------------------- GND
PA0 (Example)----------------- Trig
PA1 (Example)----------------- Echo (with voltage divider if needed)

STM32 Nucleo-L476RG       Temperature Sensor (Example - Analog)
--------------------      ---------------------------------
VCC ------------------------- VCC
GND ------------------------- GND
PA2 (Example - ADC Pin)------ Signal
```

```
STM32 Nucleo-L476RG       OLED Display (Example - I2C)
--------------------      --------------------------------
VCC ------------------------- VCC
GND ------------------------- GND
PB8 ------------------------- SCL
PB9 ------------------------- SDA

STM32 Nucleo-L476RG       Buzzer
--------------------      --------------------------------
PA3 (Example)----------------- + (Positive, possibly with resistor)
GND ------------------------- - (Negative)
```

Connection Details:

- **Ultrasonic Sensor:**
  - Connect VCC and GND to the 5V and GND pins on the STM32 Nucleo.
  - Connect Trig to a digital output pin on the STM32 (e.g., PA0).
  - Connect Echo to a digital input pin on the STM32 (e.g., PA1). **If the ultrasonic sensor's echo signal is 5V, use a voltage divider to reduce it to 3.3V.** A voltage divider with a 1kΩ resistor and a 2kΩ resistor would work. Connect the Echo pin to the point between the two resistors.
- **Temperature Sensor:**
  - **Analog Sensor:** Connect VCC and GND to the appropriate power and ground. Connect the signal pin to an analog input pin (ADC) on the STM32 (e.g., PA2).
  - **Digital Sensor (I2C):** Connect VCC and GND. Connect SCL to PB8 and SDA to PB9 on the STM32 Nucleo.
  - **Digital Sensor (SPI):** Connect VCC, GND, SCK, MOSI, and MISO (if used) to the corresponding SPI pins on the STM32. Connect CS (Chip Select) to a digital output pin.
- **OLED Display:**
  - **I2C:** Connect VCC and GND. Connect SCL to PB8 and SDA to PB9 on the STM32 Nucleo.
  - **SPI:** Connect VCC, GND, SCK, MOSI, and CS to the appropriate SPI pins on the STM32.
- **Buzzer:**
  - Connect the positive terminal to a digital output pin on the STM32 (e.g., PA3). Use a resistor in series if necessary.
  - Connect the negative terminal to GND.

4. Software Implementation (Conceptual)

Here's a high-level outline of the software you'll need to write for the STM32:

1. **Initialization:**
    - Initialize the STM32's GPIO pins for the ultrasonic sensor (Trig and Echo), temperature sensor, OLED display, and buzzer.
    - Initialize the ADC (if using an analog temperature sensor).
    - Initialize the I2C or SPI peripheral for the OLED display.
    - Initialize a timer for the 1-hour sitting timer and the 30-second reset timer.
2. **Main Loop:**
    - Display "Waiting for user" on the OLED.
    - **Ultrasonic Sensor Check:**
        - Send a short pulse to the Trig pin of the ultrasonic sensor.
        - Measure the duration of the pulse on the Echo pin.
        - Calculate the distance.
        - If the distance is below a threshold (indicating a person is present), proceed to the next step.
    - **Temperature Measurement:**
        - Read the temperature from the HW220 sensor.
            - **Analog:** Read the ADC value and convert it to temperature using the sensor's datasheet.
            - **Digital:** Read the temperature data using the appropriate communication protocol (I2C, SPI).
        - Display the temperature on the OLED.
        - Check the temperature range:
            - 35-40 degrees: Display "Moderate temperature, stay hydrated."
            - Above 40 degrees: Display "Too hot, turn on AC."
    - **Sitting Time Check:**
        - Start a timer when the person is detected.
        - If the timer reaches 1 hour:
            - Activate the buzzer.
            - Display "Take a break" on the OLED.
    - **User Absence Check:**
        - Incorporate a mechanism to reset if the user leaves.
        - Restart the 1-hour timer whenever the ultrasonic sensor detects a person.
        - If the ultrasonic sensor does *not* detect a person for 30 seconds, reset the system to the "Waiting for user" state and clear the 1-hour timer. Use a separate timer for this 30-second check.

5. Software Development Tools

- **STM32CubeIDE:** This is the recommended integrated development environment (IDE) from STMicroelectronics. It provides tools for code editing, compiling, debugging, and flashing the firmware to the STM32 Nucleo board.
- **STM32CubeMX:** This tool can help you configure the STM32 microcontroller, generate initialization code, and configure peripherals. It's highly recommended to use this to set up your project and hardware.

6. Step-by-Step Execution

1. **Hardware Setup:**
   - Connect all the components to the STM32 Nucleo-L476RG board according to the wiring diagram (and adapted to your specific component pinouts).
   - Double-check all connections to ensure they are correct and secure.
2. **Software Setup:**
   - Install STM32CubeIDE and STM32CubeMX.
   - Use STM32CubeMX to create a new project for your STM32 Nucleo-L476RG board.
   - Configure the necessary peripherals (GPIO, ADC, I2C/SPI, Timers) in STM32CubeMX.
   - Generate the initialization code.
   - Open the generated project in STM32CubeIDE.
   - Write the application code to implement the logic described in step 4.
   - Compile the code.
   - Connect the STM32 Nucleo board to your computer.
   - Flash the compiled code to the board.
3. **Testing and Debugging:**
   - Power on the STM32 Nucleo board.
   - Observe the OLED display. It should initially show "Waiting for user."
   - Place your hand in front of the ultrasonic sensor to simulate a person's presence.
   - Check if the OLED displays the temperature correctly.
   - Verify that the correct temperature message is displayed ("Moderate temperature" or "Too hot").
   - Test the buzzer by waiting for more than 1 hour (or shorten the timer for testing purposes).
   - Test the reset functionality by removing your hand from the sensor for more than 30 seconds.
   - Use the debugger in STM32CubeIDE to identify and fix any issues.