**STM32F401RE: Unipolar Stepper Motor Control on PA7..PA4**

**Overview**

This project drives a **unipolar stepper motor** using **PA7, PA6, PA5, PA4** on the **STM32F401RE** (e.g., Nucleo-F401RE board). The code outputs a repeating step pattern, toggling every ~100 ms to move the stepper.

**Features**

* **PA7..PA4** used as **4 outputs** to coils (or transistor drivers).
* **4‐step pattern** stored in an array.
* **Software delay** for timing (~100 ms per step).

**Hardware Setup**

**Pin Assignment**

| **Signal** | **STM32F401RE Pin** | **Description** |
| --- | --- | --- |
| **Stepper Coil A** | **PA7** | Driven high/low (through transistor or driver IC) |
| **Stepper Coil B** | **PA6** | Driven high/low (through transistor or driver IC) |
| **Stepper Coil C** | **PA5** | Driven high/low (through transistor or driver IC) |
| **Stepper Coil D** | **PA4** | Driven high/low (through transistor or driver IC) |

**Transistor or Driver**

* Each GPIO output typically **cannot** drive the stepper coil directly.
* **Use a driver** (ULN2003, transistor array, or dedicated stepper driver) for each coil.

**Software Explanation**

**Step Array**

* An array of 4 patterns, e.g. {0x90, 0x30, 0x60, 0xC0}, toggles the bits at PA7..PA4.
* The code writes these patterns to GPIOA->ODR, cycling through them every ~100 ms.

**Delay**

* A **simple blocking** delay approximates ~1 ms at 16 MHz, so delayMs(100) => ~100 ms.

**Main Loop**

1. **Initialize** GPIOA (PA7..PA4) as outputs.
2. **Cycle** through the 4 step patterns in steps[].
3. **Write** pattern to GPIOA->ODR.
4. **Delay 100 ms**.
5. Repeat.

**Project Structure**

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├── Inc/

│ └── stm32f4xx.h

├── Src/

│ └── main.c // Stepper control code

└── README.md

**Building and Uploading**

**Using Keil uVision / STM32CubeIDE**

1. **Open** your IDE.
2. **Create** a new project for **STM32F401RE**.
3. **Copy** main.c into Src/.
4. **Compile** and **flash** the board.

**Usage**

**1️⃣ Flash the Code**

* Build and program your Nucleo-F401RE.

**2️⃣ Connect Stepper via Driver**

* **PA7..PA4** → Stepper coil driver inputs.
* Ensure each coil has the correct driver transistor or driver IC.

**3️⃣ Observe Stepper Motion**

* The motor should step at about 2.5 steps per second (~100 ms each step).
* Reverse coil wiring if needed for correct rotation direction.

**Troubleshooting**

**🔴 No Motor Movement?**

✅ **Check that the driver inputs** are correct for your stepper coil wiring. ✅ **Verify** transistor or driver logic (ULN2003, etc.). ✅ **Ensure** you have an adequate power supply for the stepper coil.

**⚠️ Timing Too Fast/Slow?**

✅ Adjust delayMs(100). ✅ Or use a more accurate timer if needed.

**License**

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**References**

* [STM32F401RE Datasheet](https://www.st.com/en/microcontrollers-microprocessors/stm32f401re.html)
* [Nucleo-F401RE Pinouts](https://www.st.com/resource/en/user_manual/dm00105823.pdf)
* [Stepper Driver Info: ULN2003, etc.]

**🚀 Summary**

* **PA7..PA4** toggles step patterns to drive a unipolar stepper.
* **Delay** ~100 ms each step, repeated.

**Enjoy stepper control on STM32F401RE!**