

General Purpose Input Output

Objective

To be able to General Purpose Input Output (GPIO), to generate digital output signals and to read input signals. Digital outputs can be used as control signals to other hardware, to transmit information, to signal another computer/controller, to activate a switch or, with sufficient current, to turn on or off LEDs or to make a buzzer sound.

Below will be a discussion on using GPIO to drive an LED.

Although the interface may seem simple, you do need to consider hardware design and know some of the fundamental of electricity. There are a couple of goals for us:

- No hardware damage if faulty firmware is written.
- Circuit should prevent excess amount of current to avoid processor damage.

Required Background

You should know the following:

- bit-masking in C
- wire-wrapping or use of a breadboard
- Fundamentals of electricity such as Ohm's law ($V = IR$) and how diodes work.

GPIO

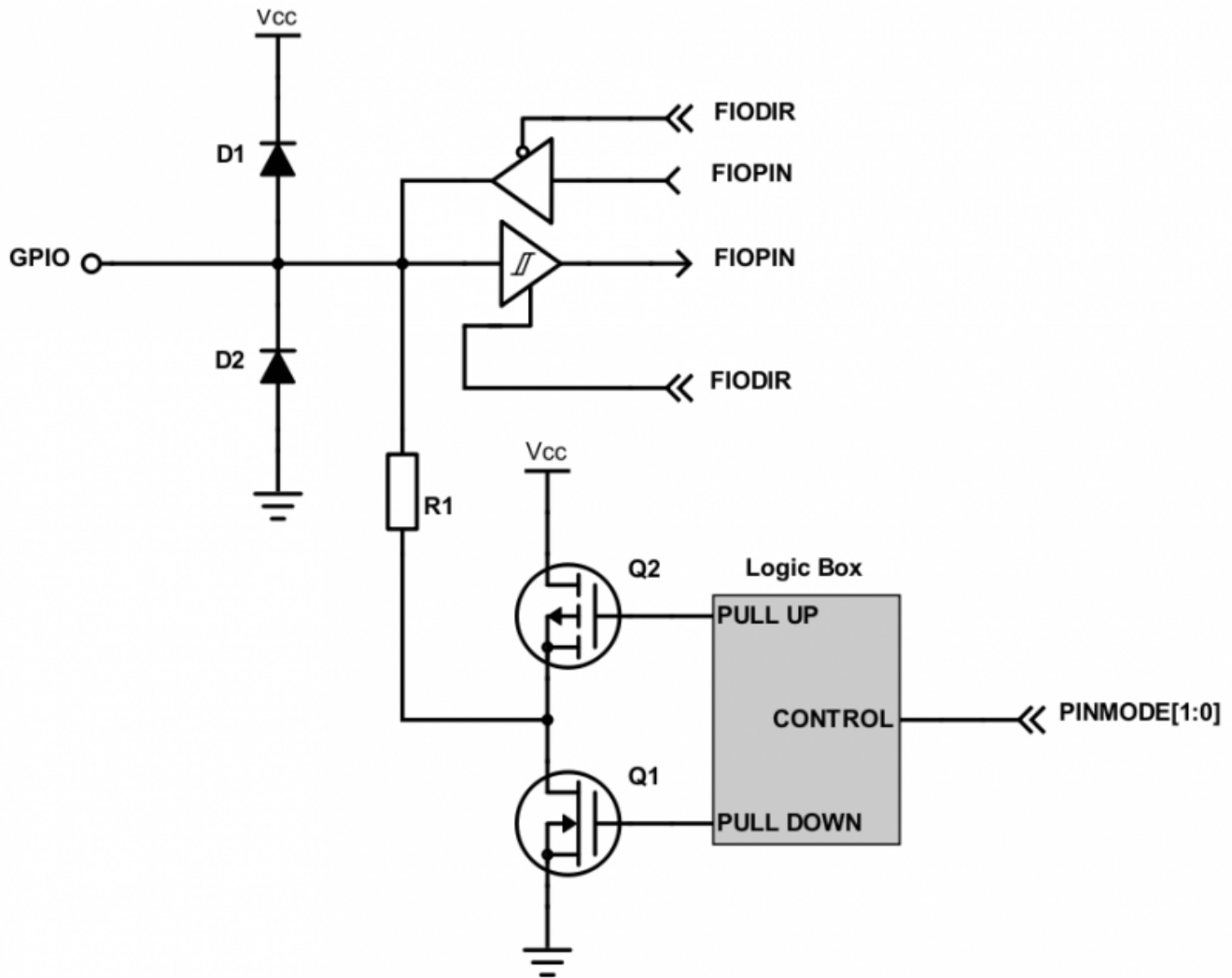


Figure 1. Internal Design of a GPIO

GPIO stands for "General Purpose Input Output". Each pin can at least be used as an output or input. In an output configuration, the pin voltage is either 0v or 3.3v. In input mode, we can read whether the voltage is 0v or 3.3v.

You can locate a GPIO that you wish to use for a switch or an LED by first starting with the schematic of the board. The schematic will show which pins are "available" because some of the microcontroller pins may be used internally by your development board. After you locate a free pin, such as P2.0, then you can look-up the microcontroller user manual to locate the memory that you can manipulate.

Hardware Registers Coding

The hardware registers map to physical pins. If we want to attach our switch and the LED to our microcontroller's PORT0, then here are the relevant registers and their functionality :

LPC17xx Port0 Registers	
LPC_GPIO0->FIODIR	Direction of the port pins, 1 = output
LPC_GPIO0->FIOPIN	<i>Read:</i> Sensed inputs of the port pins, 1 = HIGH <i>Write:</i> Control voltage level of the pin, 1 = 3.3v
LPC_GPIO0->FIOSET	<i>Write only:</i> Any bits written 1 are OR'd with FIOPIN
LPC_GPIO0->FIOCLR	<i>Write only:</i> Any bits written 1 are AND'd with FIOPIN

Switch

We will interface our switch to PORT0.2, or port zero's 3rd pin (counting from 0).

Note that the "inline" resistor is used such that if your GPIO is mis-configured as an OUTPUT pin, hardware damage will not occur from badly written software.

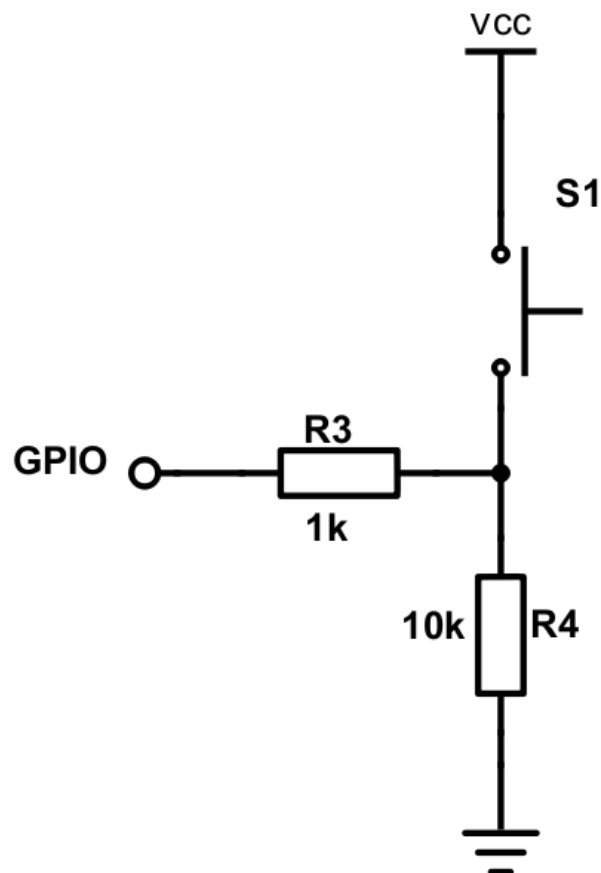


Figure 2. Button Switch Circuit Schematic

```
// Set the direction of P0.2 to input
LPC_GPIO0->FIODIR &= ~(1 << 2);
// Now, simply read the 32-bit FIOPIN registers, which corresponds to
// 32 physical pins of PORT 0.
// Use AND logic to test if JUST the pin number 2 of port zero is set.
if (LPC_GPIO0->FIOPIN & (1 << 2))
{
    // Switch is logical HIGH
}
else
{
    // Switch is logical LOW}
```

LED

We will interface our LED to PORT0.3, or port zero's 4th pin (counting from 0).

Given below are active-low config

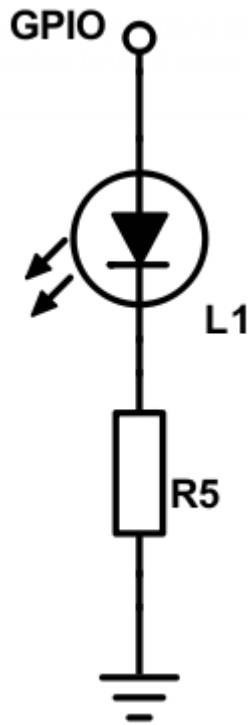


Figure 3. Active High LED circuit schematic

n LED. Usually, the "sink" current ten.

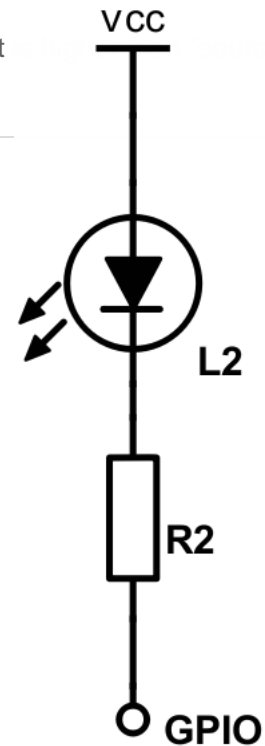


Figure 4. Active low LED circuit schematic

```
// Make direction of PORT0.3 as OUTPUT
LPC_GPIO0->FIODIR |= (1 << 3);
// Setting bit 3 to 1 of IOPIN will turn ON LED
// and resetting to 0 will turn OFF LED.
LPC_GPIO0->FIOPIN |= (1 << 3);
// An alternative way, is to use the FIOSET and FIOCLR registers (no OR logic needed)
LPC_GPIO0->FIOSET = (1 << 3);
// Likewise, reset to 0LPC_GPIO0->FIOCLR = (1 << 3);
```

Revision #1

Created 5 years ago by [Khalil Estell](#)

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