模块 8

简介：连接输入和输出

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教学目标：

学习 开关和 LED 基本原理
构建 使用 TI 的 LaunchPad 开发板构建开关和 LED 的接口电路
编写代码 将开关配置为输入，将 LED 配置为输出
设计、开发和测试
窗口入侵者检测安全系统

需要预先学习的模块： 模块 1， 2，3， 4 和 6

- 基本电路，欧姆定律（模块 2）
- 使用 CCS 在 Launchpad 上运行代码（模块 1，4）
- GPIO (模块 6)
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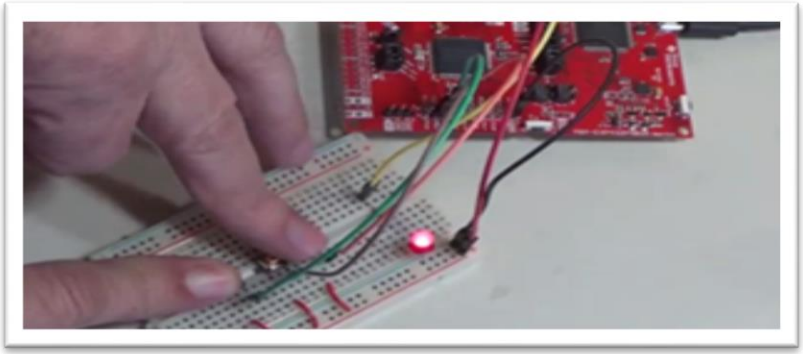
推荐阅读材料：

- Volume 1 Section 2.7, 4.1, 4.2.2, 4.3, and 4.6
  Embedded Systems: Introduction to the MSP432 Microcontroller
  ISBN: 978-1512185676, Jonathan Valvano, copyright (c) 2017

或

- Volume 2 Section 2.4, and 2.6
  Embedded Systems: Real-Time Interfacing to the MSP432 Microcontroller, ISBN: 978-1514676585, Jonathan Valvano, copyright (c) 2017



机器人系统的设计，开发和调试涉及许多任务。 任何系统的构建都涉及基本组件的知识和它们如何工作以及与通常称为**接口（interfacing）**的其他组件的连接。 实际上，我们可以将所有工程划分为子系统和接口。 接口用于将多个**子系统（sub-systems）**组合在一起以形成更复杂的系统。 在与微控制器接口的许多示例中，我们使用输入设备将数据馈送到计算机和输出设备中以允许计算机影响其周围环境。

子系统的另一个名称是**模块（module）**，它可以是软件模块或硬件模块。 软件模块的另一个名称是**设备驱动程序（device driver）**。 为了构建大型系统，我们需要一种管理复杂性的方法。 将大型系统分解为模块，而模块又分解为更小的模块，是处理复杂性的标准方法。 模块有两个方面：它的作用和工作原理。 模块化设计提供了一种抽象，允许我们将设备的功能与工作方式分开。 例如，考虑 LaunchPad 上的红色 LED，**LaunchPad.h** 头文件中有两个原型描述了这个模块的作用：

```
void LaunchPad_Init(void);
void LaunchPad_LED(uint8_t data);
```

可以在 **LaunchPad.c** 代码文件中找到模块的工作原理。良好的模块化最大化模块数量，同时最大限度地减少模块之间的**耦合（coupling）**。 耦合的一种定量测量是**带宽（bandwidth）**，或从一个模块流向另一个模块的数据量。

同样，要将模块连接在一起，我们需要一个**接口（interface）**。 在软件世界中，一个模块通过可以调用的公共函数连接到另一个模块。 这意味着 C 中的头文件定义了软件模块之间的互连。 在硬件世界中，物理设备（例如，电气，机械，化学，生物）允许模块互连。 此外，在将软件模块连接到硬件设备时，我们使用软件和硬件组件的组合来影响连接。 例如，IR 传感器是使用光学器件测量距离的硬件设备。 我们将使用光学设备（例如，传感器），电路（例如，模数转换器（ADC）和软件（例如，ADC 例程））将传感器连接到在微控制器上运行的机器人软件。

输入设备的常见示例是**开关（switch）**。 工程师在各种应用中使用开关，涉及航空航天，汽车，化工，通信，船舶，医疗，军事，石化和运输等各个行业。 我们每天在家中使用的设备中也可以找到开关。 我们在几乎所有电气和机械产品中都使用开关。
我们可以将开关分类为：

- 瞬时按钮
- 旋转开关
- 滑动开关
- 拨动开关

开关的状态是“OPEN”或“CLOSE”，可以由微控制器读取为二进制信息。 典型开关在“**未按下**”（**not pressed**）时具有 100MΩ 电阻，在“**按下**”（**pressed**）时具有 0.1Ω 电阻。 我们可以使用正逻辑或负逻辑来连接开关。 最常

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见的是，开关需要使用内部上拉电阻用于负逻辑开关，内部下拉电阻用于正逻辑开关接口。 初始化期间，软件可以启用上拉和下拉功能。

输出设备的简单示例是发光二极管或 LED。 与开关类似，LED 是二进制设备，因为它们可以是“开”或“关”的。 该软件通过使用 1 或 0 调用 **LaunchPad_LED** 函数来显式控制 LED 的状态。该学习模块将使用 LED 报告二进制诊断信息。 但是，我们可以在许多应用中找到 LED 接口，例如光缆，固态继电器，数字隔离栅和红外发射器。 LED 具有非线性电压电流关系。 连接 LED 需要了解电阻器中的欧姆定律。

将开关和 LED 连接到微控制器是一个合适的起点，因为这个过程很简单，并且学习者的行为很明显。 然而，包含在将开关和 LED 连接到微控制器的简单活动中，我们可以让学生了解设计，装配，编码和测试的基本过程。 作为实验的一部分，学生将设计**一个窗口入侵者检测系统（a window intruder detect system）**，了解他们在本单元中获得的知识。 最终，机器人将使用类似的开关来检测物体。学生们将使用 LED 显示机器人软件的工作地点和工作内容，并帮助进行调试，因为机器人系统被组合在一起以完成解决迷宫的计划任务。

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265