模块 6

简介：通用输入输出

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教学目标:

回顾 C 程序设计
理解 方向寄存器、输入和输出寄存器
探索 从光转换为电压、电压再转换为二进制的过程
学习 如何编写软件程序初始化 GPIO 引脚
设计，构建 和 测试系统
检测相对于白色区域上的黑线的位置

需要预先学习的模块：1，2，4：
使用 CCS 在 LaunchPad 上运行代码（模块 1）。
电压、电流、电阻、电容（模块 2）。
基本的 C 语言程序 （模块 4）。

推荐阅读材料：

- Volume 1 Sections 4.1 and 4.2
  Embedded Systems: Introduction to the MSP432 Microcontroller ISBN: 978-1512185676, Jonathan Valvano, copyright (c) 2017

或

- Volume 2 Sections 2.2 and 2.4
  Embedded Systems: Real-Time Interfacing to the MSP432 Microcontroller, ISBN: 978-1514676585, Jonathan Valvano, copyright (c) 2017

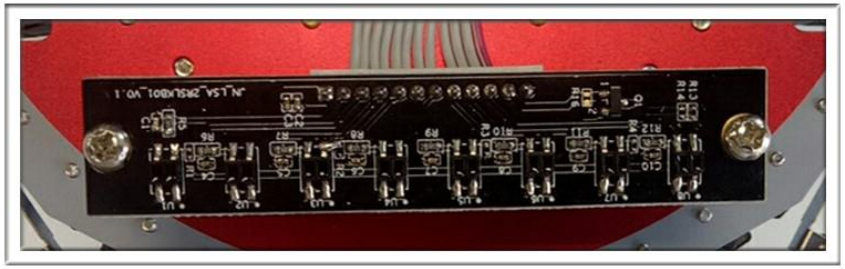

图1. 循线线传感器，位置在机器人的底部

微控制器上最简单的 I / O 端口是并行端口或**通用输入输出（general purpose input output）**（GPIO）端口。 并行 I / O 端口是一种允许软件与外部设备交互的机制。 它被称为并行，是因为可以同时访问多个信号。 端口 1 - 10 是 8 位宽，意味着一个端口我们可同时读取和写入 8 位数据。 但是并非 MSP432 LaunchPad 上的每个端口都有 8 个引脚。

输入端口（input port）允许软件读取外部数字信号。 这意味着从 **P1-> IN** 读取周期访问将返回当时端口 1 的输入上存在的值。 要进行引脚输入，我们向其方向寄存器写入 0。 对输入端口的写周期访问通常不起作用。 某些微控制器上的输入引脚具有 5V 容差，意味着输入电压可在 0 到 5.0 V 之间变化。但是，MSP432 上的引脚不具有 5 V 容差，这意味着输入电压必须介于 0 和 3.3 V 之间。

虽然输入设备通常只涉及读取端口的软件，但**输出端口（output port）**可以像常规存储器一样参与读取和写入周期。 **P1-> OUT** 的写周期将影响端口 1 的输出引脚上的值。为了产生引脚输出，我们向其方向寄存器写入 1。 由于它是可读输出，因此从端口地址进行读取周期访问将返回端口引脚上存在的当前值。 我们可以从 **P1-> OUT** 读取，返回先前写入的值，或者从引脚本身读取以查看引脚值 **P1-> IN**。

为了使微控制器更具市场价值，大多数微控制器上的端口可以软件指定为输入或输出。 微控制器使用**方向寄存器（direction register）**的概念来确定引脚是输入（方向寄存器位为 0）还是输出（方向寄存器位为 1）。 我们将初始化定义为在程序启动期间执行一次初始化硬件和软件。 如果仪器方向位为 0，则端口引脚的行为类似于简单输入，如果它方向位为 1，则端口引脚变为可读输出。 每个数字端口引脚都有自己的方向位。 这意味着端口上的某些引脚可能是输入，而其它引脚则是输出。

在与该模块相关的实验中，您将把循线传感器连接到微控制器，参见图 1。传感器的正确功能将让您完全理解方向寄存器以及如何执行输入和输出。 本实验提供了提高 C 编程技能的机会，包括使用 CCS 和示波器进行调试。 由于本实验中有测量，您将了解一些性能指标，如准确度，单调性，特异性，标准偏差（噪声）和变异系数。 在以前的模块中，您使用 CCS 在 MSP432 上开发了代码，但在此模块中，您将创建构建机器人资源管理器中所需的主要组件。 其它实验将为机器人控制器提供额外的传感器。 在**模块 10 调试中（Debugging）**，您将添加防撞开关，并使用中断实现此传感器接口。

系统开发的基本方法是创建组件，然后将组件拼凑在一起以创建系统。 在本单元中，您将设计开发和测试机器人浏览器所需的循线传感器。

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