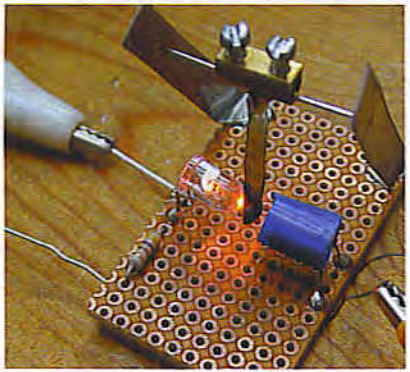
002 Attitude Sensor



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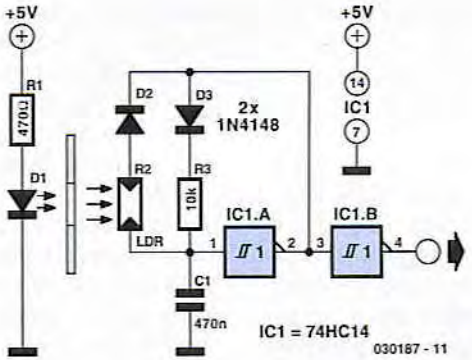

The circuit presented here (in two versions) uses a light barrier as a position sensor. In the first version (**Figure 1**), the light barrier consists of an LED (D1) for the light source and a LDR (R2) for the receiver. The LDR is part of a CMOS oscillator that generates a digital signal (pulse waveform) whose high/low ratio (duty cycle) and frequency depend on the intensity of the impinging light. With the arrangement shown in the photo, the sensor is used together with a positioner. The light-dependent resistor is more or less obscured by a pendulum, so the duty cycle and frequency of the output signal depend on the position of the actuator. If the LED and pendulum are omitted, the light falling on the light-dependent resistor can also be used to

directly determine the frequency and duty cycle.
The second version (**Figure 2**) represents a refinement of the positioning mechanism. As can be seen in the photo, it differs from the first version by using a slotted light barrier. The pendulum that swings in the slot of the light barrier is formed by two simple strips of tinplate (which can be cut from a tin), which are bound together using a cloth-covered elastic band. A bit of solder applied to the end of the strips provides the pendulum weight.

As in the first version, the light receiver (photodiode) of the slotted light barrier is more or less obscured depending on t he position of the positioner. The photodiode in turn drives a pulse generator made from two CMOS Schmitt-trigger inverters, whose duty cycle and frequency are highly variable. A dc voltage that directly indicates the position of the pendulum can be generated from the pulse waveform using a low-pass RC network connected to the output of the generator.
Suitable types of slotted light barriers are for example the TCST 1018 and TCST 2000 (Conrad).

The idea for this positioner came from working with a multi-rotor helicopter whose motor speeds had to be adjusted if the helicopter threatened to tip over. There are certainly other possible applications (such as a tremor sensor) for this sensor, which is easy to build and adjust and which responds to only a few degrees of tilt with a large change in duty cycle.

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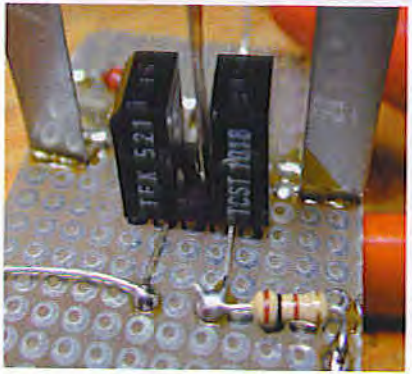

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