EXPERIMENTS

Stopwatch provides low-cost training

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This article does not propose a new experiment but describes a low-cost method that can be used for laboratory training, which is particularly useful in schools with a small budget.

We will show how you can make an inexpensive stopwatch with optical photogates, which is particularly useful with air tracks and for experiments on kinematics. All you will need is a PC with Windows Vista or Windows XP and some simple software developed in Visual Basic 2008. The other hardware needed is limited to a common USB mouse with photoresistors soldered to the left and right mouse buttons.

You can find some excellent stopwatch software on the internet [1], with external control through the RS232 port. However, a serious limitation of...
this software tends to be in the start/stop command, such that start and stop can happen only on the left mouse button or through the same switch on the RS232 port. This is a problem in kinematics experiments in this context.

Figure 1 shows the schematics of the components. In a dissected USB mouse the switches on the left and right buttons are removed. A photoresistor is soldered to the left-button pins and a second photoresistor is connected with a thin wire to the pins of the right button. Figure 2 shows a dissected mouse with a photoresistor soldered onto the pins of the left mouse button. The beams of two laser pointers illuminate both photoresistors. These photoresistors have a dark resistance of $R_d = 1\, M\Omega$. $R_d$ falls to $R_a$ in a width of 50 to 100 kΩ in a moderately illuminated room (and then acts as an off switch). When the photoresistors are in the laser beams their resistance is very low ($R_i \approx 300\, \Omega$ or less) and they then act as an on switch. When a simple Visual Basic program runs, an interruption of the L1 beam activates the time counting program. This recognizes our modified mouse as a PC mouse and is equivalent to having pressed the left button. Then, when a moving body obstructs the L1 beam, the ‘start’ of the stopwatch is activated and when the moving body obstructs L2 the ‘stop’ of the stopwatch is activated.

The major feature of this software is the active control of both of the mouse’s buttons. This is achieved because the click instruction in Visual Basic may be used indifferently on the left and right buttons. The stopwatch software is designed for a resolution of 0.01 s.

Figure 3 shows a screenshot (full-screen area) of the stopwatch. The size of the numerals are around 10 times greater than the size of the electronic stop clocks available in physics equipment catalogues [2]. This feature ensures good visibility of measurements up to 8 m away using a 15.4-inch screen typical of standard laptops.

The Visual Basic project described here is freely available in the online version of the journal.

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**References**

[1] FreeWatch (One Red Frog LLC) www.freedownloadscenter.com/Business/Time_and_Clock_Tools/FreeWatch.html; XNoteStopwatch (Dmitry Nikitin) www.xnotestopwatch.com (start/stop of this software may have an external control through RS232 serial port)


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**Equiment**

**Reap the rewards of a drier lab**

Dehumidifiers extract water vapour from the air and return the dried air—slightly heated (a nice example of 2ThD)—to the atmosphere. Lowering the humidity of the air in a laboratory has several advantages—some for specific experiments, some for general comfort. We bought a single Delonghi DN60 dehumidifier (figure 1) about two years ago from [www.johnlewis.com](http://www.johnlewis.com) to assess what improvements it could bring. It was so good that we have since bought another three.

Electrostatics experiments work much more effectively in a lower humidity environment because collisions with water vapour molecules can make charged objects slowly lose their charge.

We use polythene and Perspex rods for attracting and repelling charged plastic rods; polythene becoming negatively charged and Perspex positively charged. Putting the dehumidifier (or, better, two) in the laboratory an hour or two before the lesson makes a huge difference to the number...