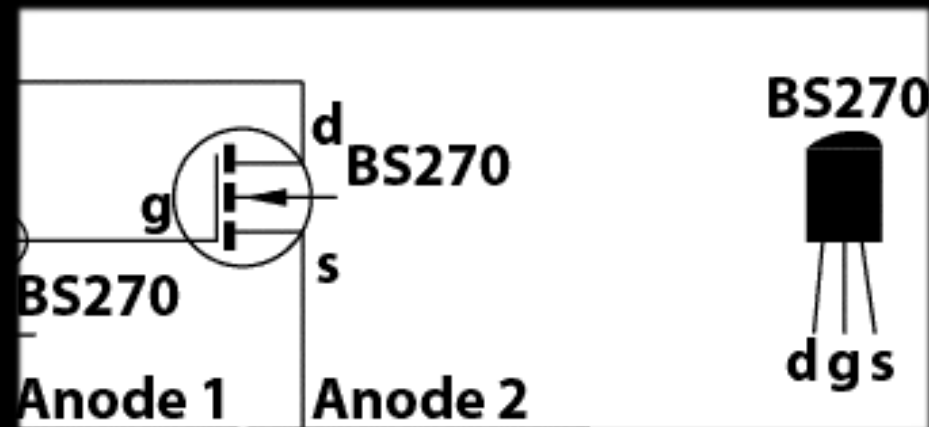


Engineering a Bicycle Speedometer

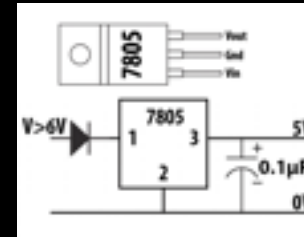
Shawn Reeves
EnergyTeachers.org (ETO)



Shawn started EnergyTeachers.org in response to teacher interest in energy topics expressed at the AAPT 2003 SM. Since then we've been finding, developing, and publishing great ideas in energy education. We recognize electronics as another 21st century educational topic.

Pedagogy and Concepts

- Hobbies not superfluous; steer the field.
- Learning goal isn't to make a device.
- Scrumptious topics
- What is speed, really?
- Don't "cover background first."



○ "Physics of hobbies," like physics for industry or physics for medicine, isn't just a way to reach people interested in hobbies, it is a way to define what physics is, to choose what topics we study. To learn more about how physics is shaped by society through non-physics pursuits like Joule's brewery, study "instrumentalism" in the history of physics.

○ You must consciously fight the simplistic goal that undercuts engineering, let alone science, the goal to get a working device. The more useful pedagogical goal is to get students to make models of speed and of characteristics of parts of circuits.

○ Topics include Hall effect; what speed is; electric switches and debouncing; many engineering possibilities like measuring spokes vs measuring once-per-rotation magnet, energy saving measures...

DONTCOVERBACKGROUND: Students can begin resistor circuits before understanding resistors, AND THIS IS A GOOD THING!

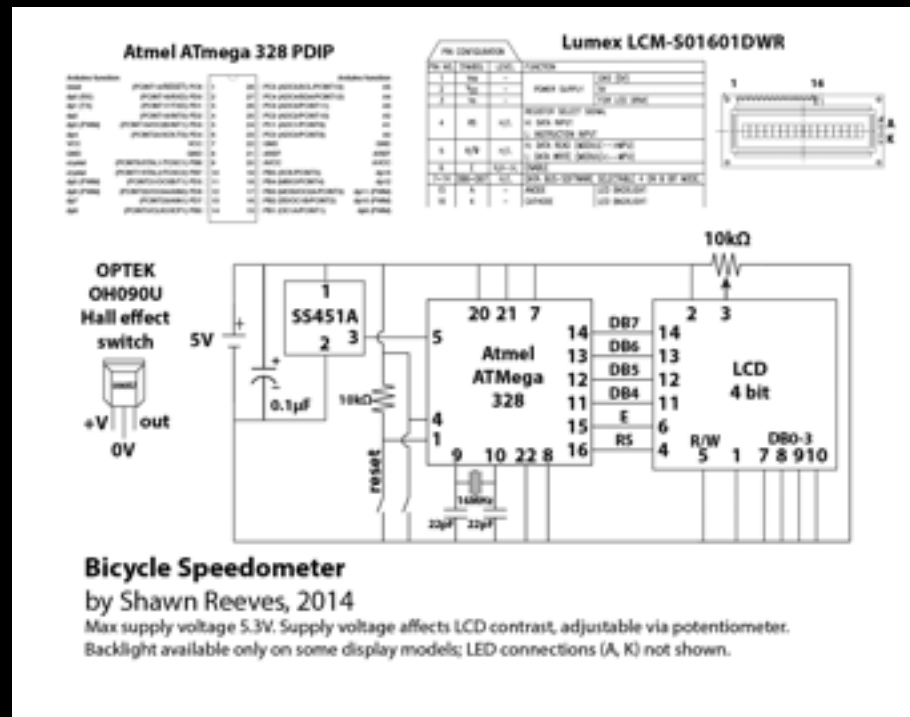
Engineering to measure speed

- Timing a single spoke or multiple?
- If reed switch, debounce.
- If hall switch or analog, characterize.
- Allowing adjustable tire size.
- Save battery energy.
- Save weight.
- Simple display, enough digits.



Concepts for building circuits

- Order of pins
- Every pin has a purpose



- Novices commonly assume order of pins around an IC on a diagram must match the order on the physical device.
- Every connection has a purpose, but you don't need to understand every one before you make it. Students can begin resistor circuits before understanding resistors, AND THIS IS A GOOD THING!

Equipment

Photogate timers.

Hall sensors, discrete (digital) or continuous (analog).

Micro-controller systems.

Breadboards

Wire

LCD display.



SD storage system.

Push-button switches.

ETO has anemometers.

Sources

http://shawnreeves.net/wiki/index.php?title=Bicycle_speedometer

Bodily activity by students to learn physics is well-explored; for example see references by Soujourner, Burgasser, and Weise in TPT 56 43-46, Jan. 2018.

Building circuits to study non-electrical phenomenon is less-well-explored.

Bicycle Freewheeling with Air Drag as a Physics Experiment. The Physics Teacher 53, 25 (2015); <https://doi.org/10.1119/1.4904237> Paul Janssen and Ewald Janssens

Sue V. Rosser editor (1995). Teaching the Majority: Breaking the gender barrier in science, mathematics, and engineering. New York: Teachers College Press.

There are many more ideas on my wiki page. Today's presentation was *not* a condensed version of it.

Getting help

- Training
- Equipment
- Consumables
- Lending
- Regional/district/school workshops
- Consultation
- Books

EnergyTeachers.org

shawnreeves.net



POST TALK NOTES:

2018-01-07: AV system not working, so gave presentation orally. Should have had handouts with web links, or a pdf of presentation on web so people could follow on devices.