February 2018

14 Build the IoT Sump Pump
Although the device described here will send a text as a sump pump warning, this project applies to pretty much anything with an appropriate sensor. An open door or window, a tripped laser beam, a pressure change on a pressure plate, a proximity sensor, etc., could all be converted into a text message warning.  

By Mirco Katalic

19 Rebuilding a Tektronix THS7X0 Portable Oscilloscope Battery Pack
When batteries fail, they can be replaced or rebuilt, but it’s usually at considerable expense. Here’s one application where a very expensive battery pack can be easily rebuilt at a fraction of the replacement cost, returning the device to useful portable service.  

By Kevin O’Connor

06 Q&A Reader Questions Answered Here
Topics discussed this month:
- Neutro the Spider
- A Clearly Better Baby Monitor

09 Open Communication
The Latest in Networking and Wireless Technologies
Connected Cars are Coming
Cars are already loaded with communications technology. AM, FM, and satellite radios are common, as is a GPS receiver for the navigation system. In the coming years, we’ll be seeing new wireless systems incorporated into every vehicle for improving safety and for aiding in the implementation of self-driving cars. Here’s an update on this communications technology.

48 Near Space
Approaching the Final Frontier
Total Solar Eclipse Near Space Flight: Part 2
A lot of data was collected on my eclipse near space flight; unfortunately, not quite as much as I hoped (some experiments failed to record data at the appropriate time). Still, there was enough data for a second article and I’d like to share three of the results with you.

22 The Arduino Graphics Interface
Part 1
See how to turn an Arduino Due and a leftover analog oscilloscope into a high resolution computer graphics display.  

By Ed Andrews WARGON

30 Light Bulbs, LEDs, and Circuit Junctions
We’ll take a look at some specific electrical properties of both light bulbs and LEDs, and use them to discuss junctions in DC circuits.  

By Tom Ready

36 A Digital Analog — Part 4
This installment in a returning series examines the more complex circuits from SSS Timer IC Circuits by Forrest Mims, which are variations on audio oscillators.  

By Larry Cichelin

52 The Design Center
Advanced Techniques for Design Engineers
Smartphone App Programming for Remote Control
This month, we’ll add Basic for iPhone (B4) and Basic for Android (B4R) to your Design Cycle, and put your iPhone to work as a remote control device. We’ll write the iPhone code using B4 and code up an I/O pin switch server using an inexpensive Wemos D1 mini and B4R.

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Develop Op-AMP Perspectives
Electronics Padawans

It’s great to have enthusiastic self-motivated students — of any age — that are into electronics. The challenge — at least based on my experience teaching teenagers — is making the students appreciate the relatively long process of mastery.

As the Jedi Padawans demonstrate in Star Wars, acquiring the first 80% of knowledge and skills may take a few weeks or months, but getting a handle on the remaining 20% usually takes years of study and practice under the leadership of a master.

To the uninitiated student, this often seems absurd. They may have learned how to ride the planet of alien invaders and conquer dozens of planets in a matter of weeks using a PlayStation or Xbox.

How much longer could it take to learn the nuances of, say, a Raspberry Pi microprocessor? Or, how to design and work with surface-mount components?

Well, if you’re new to electronics, then you’ll soon find that, as in just about every other endeavor — there’s an art involved, and mastery of that art takes time and focused study.

This isn’t to say that you can’t start enjoying the hobby from day one; it’s just that you’ll have to match your expectations with your experience.

For example, don’t expect to be able to repair your flat screen computer monitor without a year or two of experience, preferably under the guidance of a master or mentor.

If you’re a mentor to someone new to the hobby, then you may have your hands full. You’ll have to keep the overall objectives in mind — teaching, for example, the concept of resonance in an LC circuit — while making the experience as enjoyable as possible.

In my experience, this doesn’t mean shielding the student from failure. Fear from it! You want your student to fail — graciously — and come back for more. On each repeat attempt, students should be sensitized to as much as they need to do, how to do it, and how much time they’ll have to do it in.

If you’re the parent of a Padawan, then you do your part by recognizing when your son or daughter needs help. They may resist actual handling, but probably won’t say no to a budget for tools, parts, and equipment.

I went through a half dozen or so microcontrollers when I was first learning the limits of the technology. I still manage to occasionally try the analog input to a processor that I’m working with mixed 3V and 5V devices.

No Padawan’s path to mastery can be complete without the sharing of skills and knowledge with others. Today, it’s more likely to come about through social media than face-to-face meetings. Still, there’s value in sharing with others through the same process.

Mentors are invaluable, but the few-minded dozens or hundreds of eager learners who are also willing to share has value as well.

Best of all worlds is a mentor-modulated forum or actual meeting, where students provide the creativity and the mentor provides a degree of grounding in what’s likely to succeed.

Whether you’re a Padawan or helping one along your journey, teaching a mystery of electronics, may the EMF be with you.