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September 2009

EVERYTHING FOR ELECTRONICS

BUILD YOUR OWN DUNGEON KEEPER

Das BlinkenBoard Candelabra

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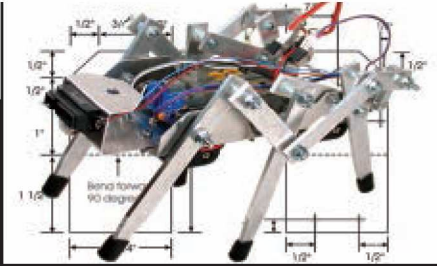
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■ BY VERN GRANER

THE DUNGEON KEEPER

BOO! Don't look now, but it's almost that time again! Before you know it, those little trick or treaters will be ringing your door bell demanding their treats. I feel the very least we can do is give them a scary good time, eh? So, how about we make an animatronic body for our talking skull and put him in a creepy coffin so he can beckon them forward with a flickering candle? Though this may sound like a pretty big project, it's actually rather straight-forward and, if you start now, you should be able to have your own Dungeon Keeper ready to thrill the kids and wow the parents for this Halloween! I had to invent my own talking skull, but if you already have the Talking Skull kit featured in the September '08 issue of *Nuts & Volts*, you literally have a head start!

THE HAUNTED TOWER

In the fall of 2003, my family and I had just moved into a new house in a new neighborhood. We thought we might be able to meet our neighbors if we really put on a show for Halloween as the area was teeming with kids. We came up with a design for a "renaissance" haunt motif simply using some black landscaping plastic and some white paint to create the facade of a castle tower. We prototyped the concept in a doorway of the house and it came out very cool (especially in the dark when back-lit!). So, we took the concept and ramped it up, painting a two-story tall piece of black plastic and then hanging it up on the front of our house (**Figure 1**). We called it "The Haunted Tower."

Unfortunately, inside our very scary Haunted Tower was a rather non-scary contemporary front door. I decided to replace it with a home-built "dungeon door" that had a speak easy type of sliding peep hole to allow us to interact with visitors (**Figure 2**). The speak-easy peep-hole was large enough to allow someone in costume to interact with the trick or treaters (**Figure 3**), but I didn't like the idea of some guy in a mask (likely me) getting stuck with poking his head out the door to say "boo!" all night. I wanted to try my hand at a fully animatronic character. I figured a "talking skull" type creature would be perfect so I went on a quest for a decent model skull I could convert into my Dungeon Keeper.

GETTING A HEAD

Back in 2003, when I first envisioned creating a

■ FIGURE 1. The large-scale tower facade. (inset) The Haunted Tower facade in place.

talking skull for my Haunted Tower, I hadn't yet discovered the Talking Skull Kit so I decided to roll my own. I started by searching for something I could hack into a scary animatronic prop. As luck would have it, I found a novelty singing "Big Head" skeleton from a big-box store here in town.

I removed the skull from the small plastic body, then opened the skull to discover a small DC motor that was used to open the jaw (**Figure 4**). This is fairly typical in this type of low-cost animatronic as the driving circuit simply applies power to the motor and it moves to a stall point until power is removed. This causes the mouth to open and close but it really gives you very little control over the position of the jaw. I decided a servo motor would do a much better job and would allow me to control the position either via programming or by using a circuit to convert audio to servo control signals.

I removed the DC motor and modified the mount to hold a servo motor (**Figure 5**). I then reassembled the jaw and tested the motion using my RC control system (**Figure 6**). The jaw worked very well, was very responsive, and relatively quiet. So, now that I had jaw motion, I decided that the simple red LED eyes had to go.

■ FIGURE 2. The Dungeon Door with peep hole closed.

■ FIGURE 3. The Dungeon Door with peep hole open and masked monster showing.
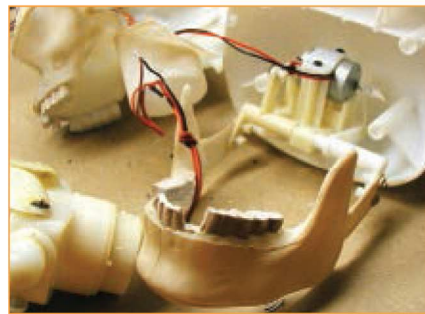

■ FIGURE 4. The DC motor in the jaw motion assembly.

■ FIGURE 5. The new servo motor in place in the jaw.

ANIMATRONIC EYES? I SEE!

After removing the red LEDs, I used a Dremel tool to remove some plastic material from around the eye sockets. This made a large enough area to allow the installation of hard plastic eyeballs that I had found at a party/novelty store (**Figure 7**). I bent a large paperclip to make a gimbal that would hold both eyeballs while allowing them to turn left and right. Another paperclip created the gimbal at the rear of each eyeball that allowed the servo motor to pan the eyes left and right (**Figure 8**). I decided against trying to fabricate an up/down mechanism as the skull would have the ability to look down by tilting (just as soon as I gave him a neck to stand on!). I added blue colored LEDs to the backs of each eyeball so I could make them glow and ran the wires for the servos and LEDs down through the throat of the skull.

■ FIGURE 6. Testing the servo controlled jaw motion on the reassembled skull.

I AIN'T GOT NO BODY!

For me, PVC = EZ! You can make things
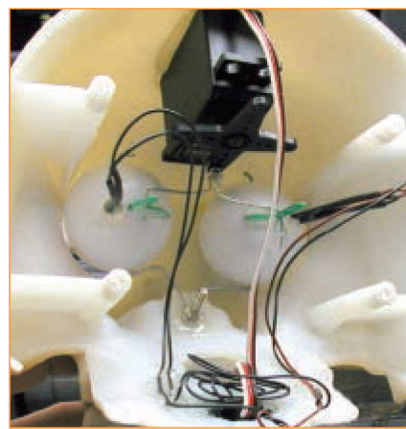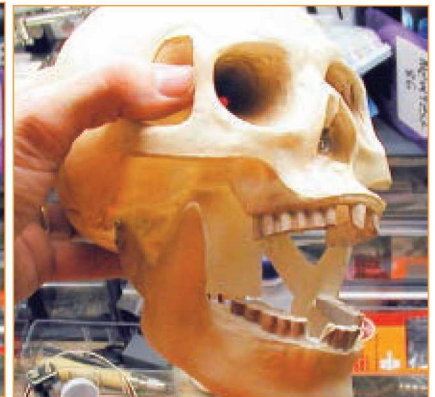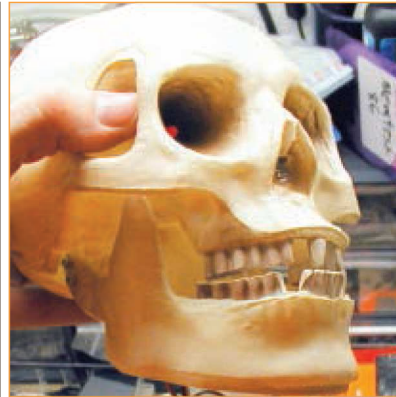
■ FIGURE 7. Eye motion servo connected to eyeball gimbals.

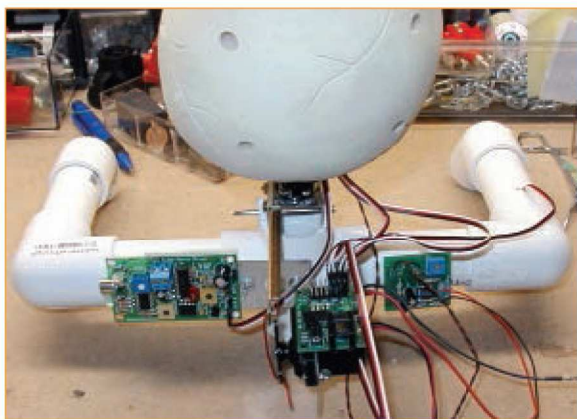■ FIGURE 8. Front view of skull with servo operated eyes.

■ FIGURE 9. PVC body with hips mounted flush to the Dungeon Door; arms extend through the peep hole.
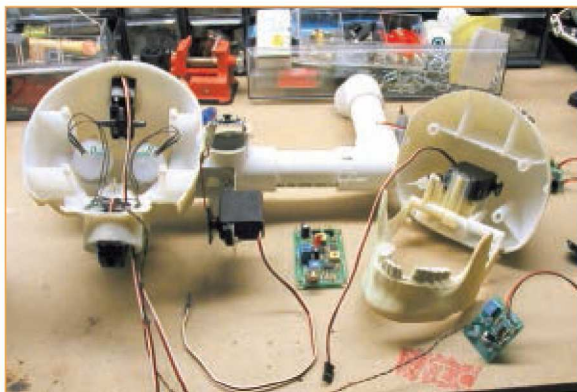
■ FIGURE 10. PVC shoulders with skull tilt gimbal in the center.

■ FIGURE 11. PVC Shoulders with skull attached and all electronics in place.

■ FIGURE 12. The Dungeon Keeper greets trick or treaters at the Dungeon Door on Halloween.

that friction-fit together very well and are surprisingly strong. The parts are relatively inexpensive and if you decide you want something a bit more permanent, all you have to do is add a bit of PVC cement to your design. The fact that the PVC pipe is hollow and makes for easy wire runs is an added bonus.

So, when I needed a neck and shoulders to place my animatronic skull on, I just went out to the garage and dug around a bit in the bin of PVC fittings I have. I came up with some 3/4" PVC that I quickly shaped into a neck, shoulders, wrists, and torso that fit perfectly on the back of the Dungeon Door (**Figure 9**). After the test fitting on the door, I removed the neck and shoulders and took them back to my work bench to figure out how to mount the skull.

To give the skull the ability to pan left/right, I added a servo motor into the neck of the skull facing down (this turned out to be a less than optimal design choice as I will describe later). I then built a small platform on the top of the PVC shoulders that would allow the head to tilt up and down (**Figure 10**).

By this time, I had finally discovered Scary Terry's sound-to-servo board and I had ordered a kit from Cowlacious Designs. I mounted the sound-to-servo control board on the left shoulder, a serial servo controller in the center, and an LED PWM fading circuit on the right shoulder (**Figure 11**). I added a flickering neon candle and a pair of skeleton gloves to finish him up and he was ready to scare some trick or treaters and hand out candy (**Figure 12**).

SHOW TIME!

When the big night arrived, we had kids coming from all over the neighborhood dragging their parents to come see the talking skull in the scary tower! Though the night was a big success and I really like the effect of him mounted in the Dungeon Keeper, there were a few issues that made me reconsider. For example, to operate the prop you would open the peep hole door, then lean the body of the Dungeon Keeper out the window. This seems simple enough, but in practice, it's kinda tough to pull the rope to open the peep hole, tie it off, and push the Dungeon Keeper forward through the window all while trying to trigger the audio sound track, activate the animatronic motion, and juggle a bowl of candy! At one point during that first night of operation, I pulled open the door and slammed the body forward in an attempt to give the kids a good startle. Unfortunately, when his body hit the door, his skull snapped off at the neck and was

■ FIGURE 13. Kym Graner fits together pieces of the Toe Pincher Coffin.

Bruce Tabor adds internal reinforcements to the coffin.

■ FIGURE 14. The complete toe pincher coffin after painting, hardware, and interior finished.

■ FIGURE 15. The EFX-TEK Prop-1 board.

left dangling outside the door by its wires!

I managed to put his head back on with hot melt glue and wire ties so he lasted out the evening, but this was a good lesson for me on designing for stress situations. Based on this experience, when I overhaul him, I plan to remove the servo from his throat (the one that controls head pan) and place it below the skull (like the tilt servo) so all the weight of the skull will be taken by a gimbal to avoid this issue in the future.

The little "Oops! My head popped off!" issue wasn't the only problem with the design. The door itself was rather large and cumbersome, and provided little protection for the skull and the somewhat delicate wiring and electronics that were exposed on the back side. Also, if taken out to show, people would be able to clearly see behind the animatronic making it harder to stage for performance.
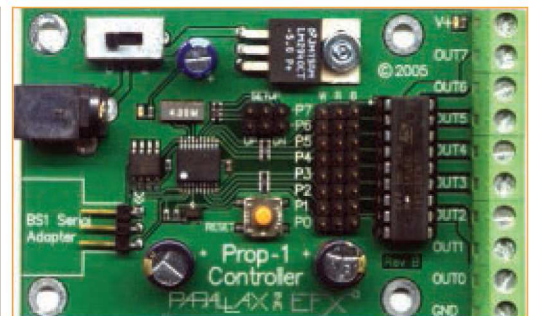
Lastly, the sheer size of the door plus the exposed electronics made for difficult storage as the unit wouldn't lay flat, and the electronics and moving parts were all exposed to accidental damage. All in all, it was time to consider a different box for this project.

A PROJECT BOX TO DIE FOR!

I've made all sorts of enclosures over the last couple of decades to house various projects, but this project box would be the biggest I'd ever made. I ran across the "Single Sheet of Plywood Coffin" plans when perusing the monster list of Halloween projects sometime in 2004 (see Resources). Originally developed by **CasaDeSade.com**, this ingenious design creates a life-size coffin from a single 4' x 8' x 1/2" sheet of plywood!

As always, I turn to my friends when I need expert help. It just so happens that my good friend (and carpenter by trade) Bruce Tabor was kind enough to offer use of his table saw, pneumatic nailer, and top-notch carpentry skills to speed up the construction of the coffin. We cut out all the pieces and then assembled them using a bit of

■ FIGURE 16. The Dungeon Keeper animatronic after transplant into the coffin (undressed and dressed).

scrap lumber to hold the corners (**Figure 13**). Once painted, we had a pretty amazing haunted house prop (**Figure 14**).

Since I planned to transplant the Dungeon Keeper animatronic into the coffin, I discovered this made a lot more sense than leaving him mounted to the Dungeon Door. For example, the coffin gave us a place to keep the power supply, lights, a nice sound system with a sub

Das BlinkenBoard Update!

Once again, Das BlinkenBoard comes to the rescue — this month in the form of a theater and haunt safe candelabra! With the help of Marvin "Professor Conrad" Niebuhr, we have placed a BlinkenBoard inside a PVC and wood stage prop candelabra. Using the default flame simulator program built into the microcontroller, we can simulate flames by placing one red and one yellow LED in each of the four cups, then use some hollowed out candles to act as diffusers. This is a work in progress with more details to come in the next issue!

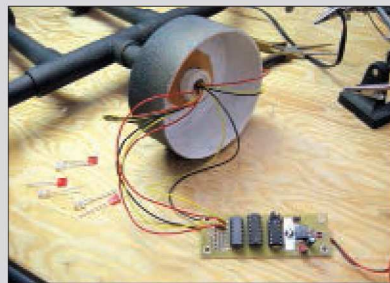
PVC pipe ready to be assembled.

Assembled candelabra.

Primed, textured, and painted.

Wiring the left side.

Wiring the right side.

Attaching Das BlinkenBoard to the base.

The LEDs ready to be attached to each candle holder.

Red/Yellow LEDs ready to go into candles.

woofer, a CD player, and even a microcontroller.

RANDOMLY SCARY?

When the Dungeon Keeper was first used, I had head tilt, head pan, and eye pan which were all controlled by a Windows computer using software from Reynolds Electronics called "Robo-Ware" (see resources). This software allows you to choreograph the position of each servo by setting targets. Though you can create very precise motions using the software, the downside is that you must specifically program each position for each servo and — as you might imagine — this can be very time-consuming. However, if you want very precise control of your animatronic creation, it's a very good choice.

In my situation, I planned to use the Dungeon Keeper in a number of different scenarios and didn't want to hassle with creating new motion programs for each show. I decided

RESOURCES

Videos of The Dungeon Keeper
www.youtube.com/VernGraner

Talking Skull Kit
http://store.nutsvolts.com/home.php?cat=388

Monster list of Halloween Projects
www.halloweenmonsterlist.info

The Halloween "L" - Halloween Enthusiasts Chat
www.wildrice.com/Halloween-l

Technical Insanity: NO chat, Just Tech Talk
**http://groups.yahoo.com/group/
Technical_Insanity**

One Sheet of Plywood Coffin
**www.shallowvalley.com/pincherplansprint.html
www.notepad.org/DungeonKeeper**

Robo-Ware Servo Automation Software
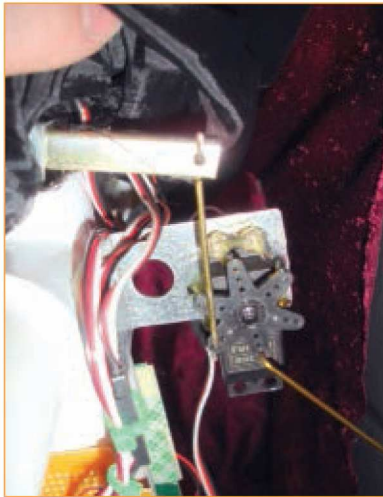**www.rentron.com/Robo-Ware.htm**

Vern's Six Servo Random Motion Program
www.spiderspreyground.com/howto/prop-1

Jon Williams Six Servo Code Optimization
**www.efx-tek.com/
php/smf/index.php?topic=675.0**

EFX-TEK
www.efx-tek.com

International Association of Haunted Attractions
www.iahaweb.com

Professor Conrad
www.professorconrad.com

FIGURE 17. The second push-rod that makes the chest move forward when the chin lifts.

FIGURE 18. Kids get a chance to see how the Dungeon Keeper works at Armadillocon.

can be closed up when he's not in use. Also, I pack a scrolling LED sign inside him as well, so that he can be used as an advertising system. The front of the coffin is removable so we often display him at events with all the covers off so folks can see how he works (**Figure 18**).

If you'd like to see The Dungeon Keeper in action, drop by my YouTube channel where videos of him in various performances will be available. If you end up building a Dungeon Keeper of your own, I would love to hear about it! Please feel free to email me at vern@txis.com. **NV**

that it would be easier to just use a microcontroller to move the servos and use a random number generator to pick the target positions. This way, the character would stay in motion continuously (in a mostly unpredictable manner) without the necessity of programming all the actions. In addition, transferring control of the servos to a microcontroller eliminated the need to have a full Windows-based computer available whenever I wanted to operate the animatronic.

Lucky for me, about this time Jon Williams from Parallax had partnered with John Barrowman to create EFX-TEK, a company that was creating robust BASIC Stamp-based microcontrollers for use in the special effects and haunted house industry. I was lucky enough to get a prototype of the Prop-1 controller from Jon and John at Hauntcon in Dallas (**Figure 15**). I wrote some code that would allow the Prop-1 to cause six servo motors to move to random positions at random speeds. I made the software available for download from my website and gave Jon a copy that he then went on to optimize and release on the EFX-TEK website (also listed in Resources).

THE DUNGEON KEEPER AT HOME

So, now that we had the Dungeon Keeper mounted in his new coffin (**Figure 16**), it made it very easy to upgrade and improve his operation. For starters, I added a connection from the head tilt servo to the back of the cabinet so when he lifted his head up, his chest would move forward (**Figure 17**). This allowed me to get two motions using a single servo. Next, I added a nice-sounding computer speaker system with a sub woofer and a portable CD-ROM player so I could trade out his sound tracks and dialog at any time (my daughter seems to think its incredibly funny to put Britney Spears CDs in the player). I made his right arm removable so the coffin