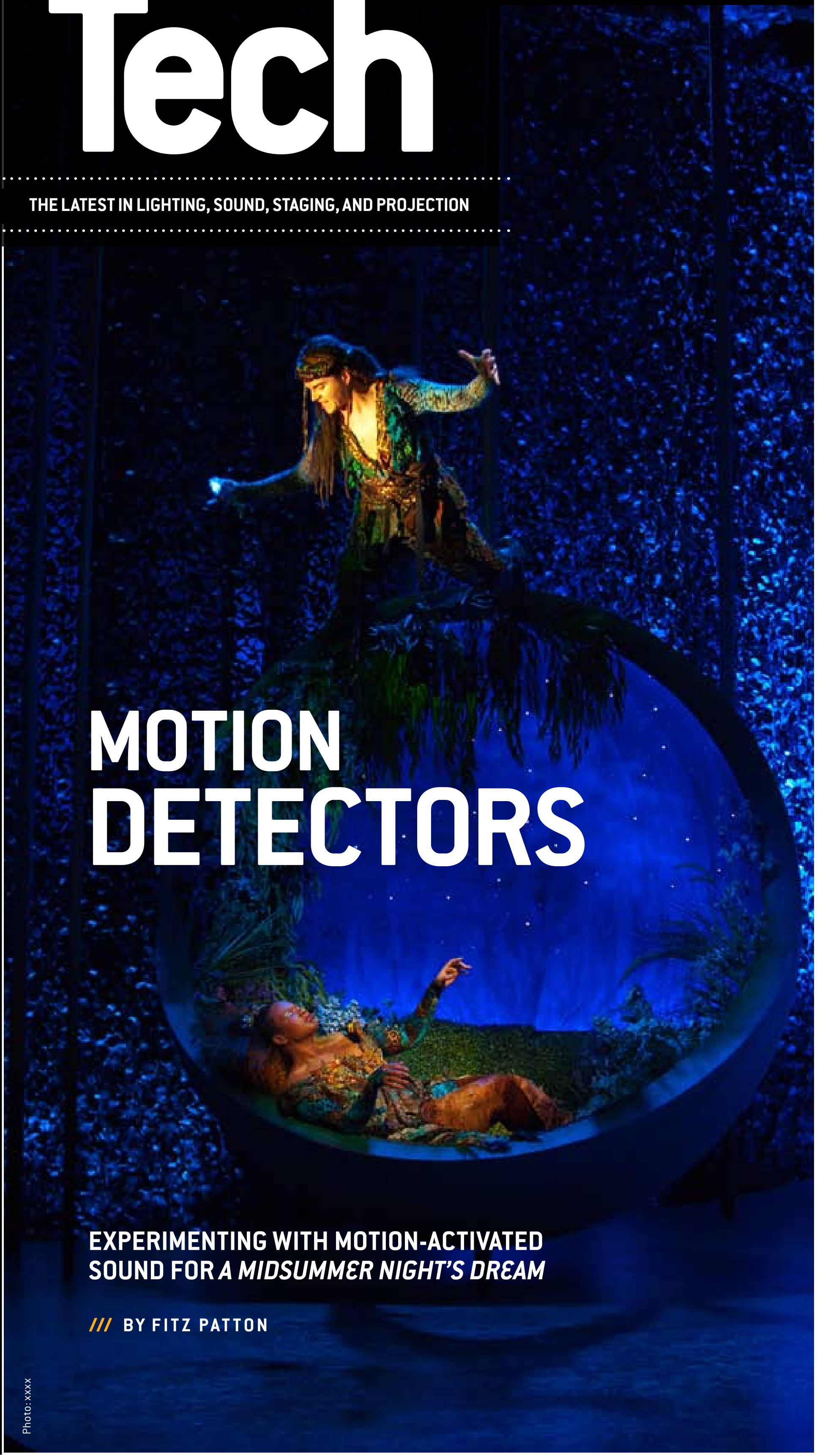
Tech

THE LATEST IN LIGHTING, SOUND, STAGING, AND PROJECTION



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MOTION DETECTORS

EXPERIMENTING WITH MOTION-ACTIVATED SOUND FOR *A MIDSUMMER NIGHT'S DREAM*

/// BY FITZ PATTON

Who calls the cues in your life? Maybe it's religion or a higher power. If you're in the theatre, it's another higher power, and she has a microphone. Those of us who create virtual environments depend on the latter to replicate the former, but are all sound events the same.

The curtain rises on breakfast. We see a disheveled overgrown teenager, aged 47, making breakfast with one eye open. It's a big house, so we've reinforced the scene with a few key sounds, but the stage manager has had a bad night. The actor bangs the skillet to the stove (*silence*), cracks the egg on the skillet (*loud metal clank*), drops the egg in the pan (*sound of egg shell*), finishes up, puts the pan in the sink, runs the water, and she calls your egg fry cue. *Voila!* You're back on track, and they sound the same.

Typically, though, there are two kinds of "late" for sound designers: the simple fact that sound is slower than light and the physiological reaction time of stage management and operator to visual events. We know a good deal about the slowness issue, and we spend and plan mightily to adapt to it. So what about the physiological?

At livedesignonline.com, we present the results of our experiment examining the phenomenon of sound cues that are called on visual events; we ask whether the consequences of this lateness are material to the success of our work. As creators of virtual experience, the unity of visual and aural perception is critical to our success, but in theatre today, when the doors close behind us and the lights go down, the curtain rises on a strange world of evenly drawn latency.

The visual/aural time-field is conditioned with a ritualized, perceptual softness, or misalignment of these events. It's an aesthetic of patterned, even lateness that subtly reveals "the man behind the curtain." Perceptual softness pervades our senses in the

///Puck and Lysander

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theatre, and the constant cognitive effort on the part of the viewer to factor out this effect comes at a cost to every production, no matter how small.

Pucks Jump

The University of Delaware Resident Ensemble Players/Professional Theatre Training Program (PTTP) production of *A Midsummer Night's Dream* this past fall featured the work of director Sandy Robbins, set designer Takeshi Kata, lighting designer Tom Hase, costume designer Martha Halley, and yours truly on sound design. It provided the perfect opportunity to introduce the Arduino microcontroller to resolve specific kinds of visual and aural events that suffer most from the neurological latency of manually called cues. This discussion is neither a self-congratulatory victory lap (the system remained experimental) nor a cautionary tale (it does work). This is more of an invitation to all designers of virtual reality, both visual and sonic, to take an active role in, and responsibility for, solving an endemic problem that doesn't have to remain a given in our productions.

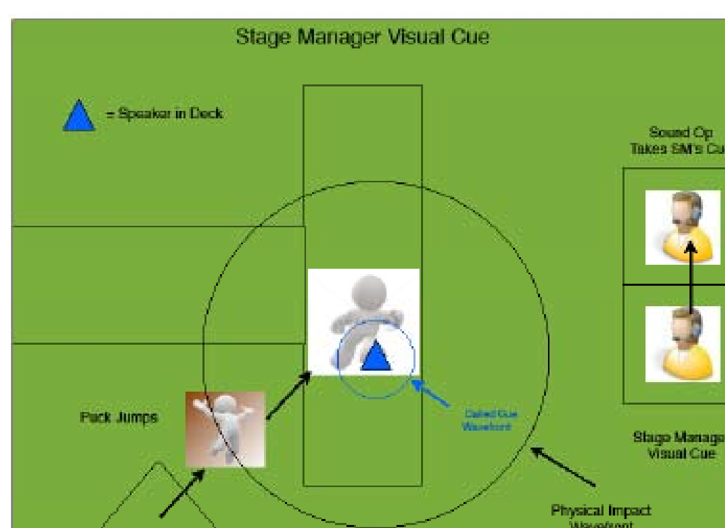
Setting himself at ready in the house-left orchestra box, Puck prepares to jump 10' across the audience view onto the end of the hanamichi stage section. His cue comes, and he leaps. A light catches him mid-flight, and, extending his feet forward, he impacts the deck with a thunderous accompaniment from the sound system and a not so thunderous one from the deck itself, all amid a stunned audience.

We want these two events to occur together. While we know what "together" means in *theory*, what does it mean in *practice*? The mind resolves aural information at a substantially faster rate than visual information. While we require a minimum of 30 samples of a light wave per second to simulate visual reality, our mind can detect arrival time differences in sound to within 1/300th of a second—30 times greater. Consequently, the impact of human, even expert, cueing is greater in those instances where sound and light must seem to be aligned.

Let's go back to Puck's jump. What does the human-resolving power of arrival times mean for the perceived simultaneity of his impact? Puck leaps into the air, the stage manager watches—she has practiced—she cheats back her call, gives the *go*, Puck strikes the stage, the image of the impact and the sound wave from the deck travel out immediately (at different rates), the sound operator presses the spacebar, the sound computer goes... *later.* (Check out livedesignonline.com to see just how much; the results may surprise you).

The stage manager's call does not have to be technically simultaneous. In fact, she has plenty of wiggle room, exactly 1/300th of a second's worth. Any firing time within the perceivable range of 1/300th of a second will be perceived as simultaneous. Is this possible using visual/manual called cues? Technically, no—the response time of the stage manager is compounded by the response time of the operator, who may not be able to see the stage for his own visual go. Does this matter? Absolutely.

As a fundamental responsibility of technical precision, we are required to resolve visual and aural events to the finest degree to which we are capable, within the given means of production. Why? Because theatre is increasingly seen as a live



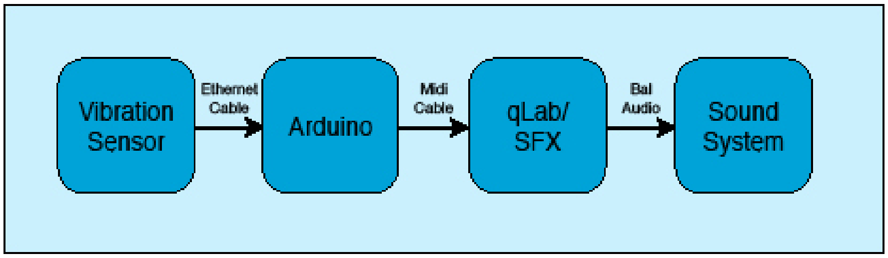
///Vibration Sensor - Called Cue.pdf

> "When the doors close behind us and the lights go down, the curtain rises on a strange world of evenly drawn latency."

virtual space—a place where the accurate recreation and replication of natural and psychological events is critical to the success of the entire undertaking. When you think about it, the frustration we all feel with back-of-house seating is not just our distance from the stage, but also the dilation of the difference in time arrivals of our visual and aural experience. This dilation can reach as much as 1/20 second in back-of-house seating on Broadway, or 15 times the resolving power of the auditory senses, affecting a near complete perceptual disjunction. Add to this the delay in cueing using the two-person stage manager/operator scenario, and the delay becomes greater.

Looking at the world of cueing from this perspective, we must plan for three kinds of sound cues: **1**. sounds for which there are no immediate visual complement, in which case the cueing time is governed by other concerns, **2**. cues that have a silent visual complement, in which case the sound support must be instantaneous and executed without delay, and **3**. cues that have a visual and aural complement, in which case the wavefront of the live event would be matched perfectly with its operator-cued complement.

Puck's jump, a close encounter of some other kind, is a strong visual combined with a strong onstage *and* cued sound. Here, every aspect of visual and aural acuity is at its highest, and our responsibility for resolving the sound cue with the visual event *and* the wavefront of the percussive sound his impact creates is imperative. Keeping in mind the the perceptual awareness rule of 1/300th of a second—that everything cued within this range, either before or after, will be perceived as simultaneous—we introduced the Arduino microcontroller and a vibration sensor.



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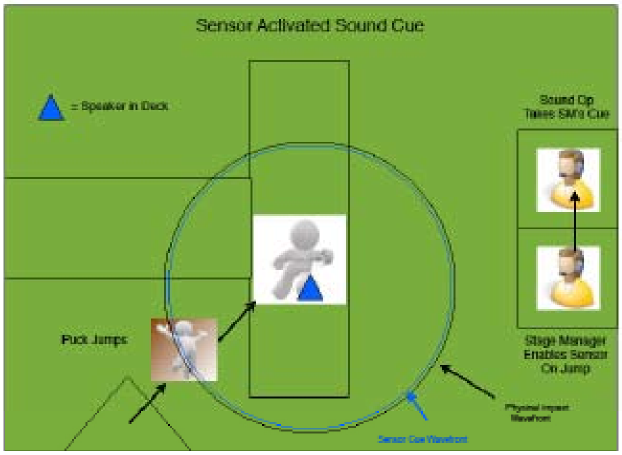

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Puck jumps again, but this time, instead of calling the impact cue, we place a vibration sensor under the deck at the point of impact and program the Arduino microcontroller to look at the sensor 1,000 times per second (three times the rate of human perceptual acuity for arrival time) and respond with a go. Puck flies through the air, impacts the deck, and though as much as 1/1,000th of a second late, the sound fires within the span of the audience members' resolving power, sending out a wavefront that is within 1' of the live impact sound, a significant accomplishment considering that sound travels 1,024' per second. The problem is solved. We have unified perceptual reality.

Into The Woods...

In a future article, I'll discuss the creation of stochastic natural sound fields, but a worthy question for this discussion is when to use microcontrollers and sensors to cue them? If you've been paying attention, Puck has landed, and we are perfect. He slips Demetrius a mickey, runs down the hanamichi across the stage, and jumps into the darkness while Lysander and Helena enter stage left.

We wanted to vivify the forest with the sound of brush, twigs, and other sounds that accompany a run in the woods. Underbrush is a complex sonic event. Small twigs in the brush are both at waist level and underfoot. This accumulation is layered

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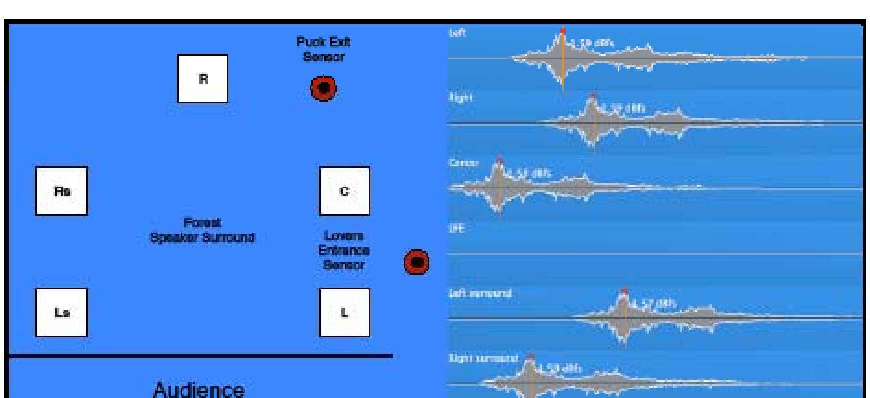
and connected to other organic matter, creating a complex, stochastic sound event of related, repeatable parts in a non-repetitive, rhythmic sequence with a contained, and yet unpredictable, sound image dispersed across the area of encounter.

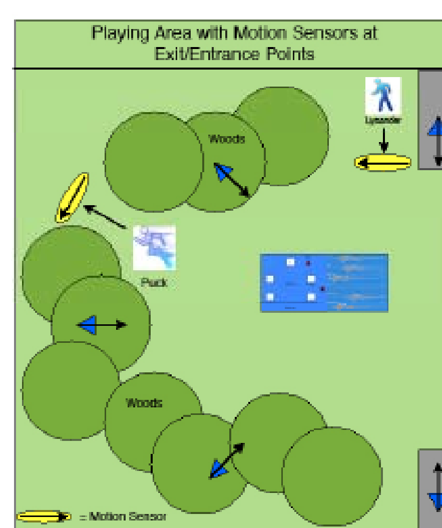
In this case, a combination of multichannel (spatially encoded) sound files and sensor technologies is the answer. A motion sensor, using an enclosure developed by Keith Davis of PTTP Delaware, is used to trigger a six channel sound file that plays across a field of activity surrounding the point of entrance.

While a cue is called, enabling the sensors for these two areas, when the detection beams go live, it is the Arduino that calls the cue. Even as Puck flies off into the darkness, his body activating a strong brush sound mid-flight, Lysander's and Helena's entrance is properly anticipated, with a separate sensor cueing their six-channel brush event well in advance of their appearance on stage, as it should. We first hear a distant crackling that becomes more active, peaks, and then subsides with their entrance.

While, in the case of Puck's jump, we're solving a hard-and-fast timing issue that lies technically beyond human capability, in this application of microcontroller technology, the forest is an active sculptural space within which the performers move. In both cases, we're resolving the audience experience of visual and aural perceptual senses, unifying these into a single theatrical beat, as well as saving considerable tech time rehearsing this complex event. The integration of sensors within the visual design to unify the virtual time-fields of sound and image to effectuate the creation of a unified sensory environment is becoming an attainable and necessary goal. Let's embrace it, and put our days of perceptual softness behind us.

For more information on the Arduino microcontroller visit: www.arduino.cc. LD





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