

Artistic Elements and Practical Challenges in A Midsummer Night's Dream with Unmanned Vehicles

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Abstract—This paper examines some of the artistic elements and practical problems encountered Texas A&M's 2009 production of William Shakespeare's *A Midsummer Night's Dream* in which teleoperated unmanned vehicles were involved. From the beginning, a major concern was whether robots would distract from the play, undermine the characters, and harm the world which the playwright had envisioned. The play itself had been selected before any role for robots was considered. Several directorial, costume and staging decisions were made in order to ensure that the robots would be an integral part of the production. In the end, the production was a success, and it was widely felt that our concerns had been staved off. We describe our experiences, highlight and reflect on these integrative decisions, suggesting that they may be a useful starting point for generalization to other theatrical works.

I. INTRODUCTION

This paper reflects on the production of William Shakespeare's *A Midsummer Night's Dream* at Texas A&M University in which seven flying unmanned vehicles, dubbed "fairies", joined human actors during public performances from late October to early November 2009. The performance, previously described in Murphy et al. [1] and in the popular media¹, was a collaborative project between the Departments of Performance Studies and Computer Science and Engineering (CSE). While elements relating to affect, priming human expectation, and social proof as it pertains to broader human robot interaction have been examined (these comprise the main contributions of [1] and [2]) little has been documented regarding the artistic and directorial choices involved, nor have aspects of planning, development, rehearsal stages of the production been described. This paper examines these parts where we feel there are lessons or ideas that could be of use for the robotic theatre community. Generally the parts combined elements that were top-down, driven by a vision for what the production was to be, and bottom-up, by identifying and working around constraints imposed by hardware, space, timing, and so on.

Technology in the arts is primarily viewed as enabling and not transformational. This may be a cultural effect rather than an instance of the broader platitude that using new technology involves risks. In dramatic arts at least, one hears of commercial theatres investing in some technology and foisting it on a production. Apart from the challenges caused by some technology that is simply too complex to get operational, the play may not be written with the technology in mind and there is the danger that it will form a foreign presence within a production. Technology is not traditionally



Fig. 1. An AirRobot 100-b quadrotor named Virginia, shown here in costume, with all the fairies. Photo by Jane Martin.

considered a key element during the development of a new production and, in many cases, technological integration may only occur during tech week. The *Midsummer* production was a cooperative effort in which the role of technology was negotiated throughout the creative process. The precise use of robots (what they should do, and what they could do) and considerations about whether they would undermine the content of the play were of serious concern from the outset. The production was deemed a success by the director, the actors, responses drawn from the audience, critics, and ticket sales; we feel that the artistic strategy, methods employed for integrating technology, and participation of roboticists may form a useful model for future efforts.

Motivation for the production

The different parties involved had different motivations for exploring how robots could be included in the production. (The following categorization is purposefully broad.)

Artistic motivation: As the director (Hopper) put it, the question "will it succeed?" has the potential to infuse a production with the drive and verve that is sometimes so lacking from contemporary theatre performance. If anything, the adoption of a classic of the Western canon raises the stakes in this regard.

Human-Robot Interaction Research: Developing an expressive behavioral repertoire is important in applications in which robots need to instill trust and maximize their influence (e.g., when a robot approaches a human in a rescue situation). The dramatic arts provide an environment in which one can prototype behaviors

¹Specifically, wired.com, gizmodo.com, and engadget.com, as well as the blog of the Autonomous Robots journal.

which communicate clear messages and maximize affect. Theatre contributes specific principles for physical communication and animacy, (*e.g.*, emphasizing the size of an actor’s reaction to a cause). Moreover, it provides a framework of direction, rehearsal, and note giving/taking which improves how information is conveyed. Finally, the culture, outlook and creative methodology employed by practitioners of the performing arts are distinct enough from those of engineers that important cross-pollination occurs.

Broadening participation and Outreach: An audience consisting mostly of college students were re-introduced to Shakespeare in a contemporary and unique way. Robots helped increase the visibility of the production, and attracted larger audiences than expected (shows for the second week sold out and, had it been possible, the run would have been extended). Computer scientists and engineers participating in the production invited their friends and engaged people who are not traditionally theatregoers. Also, posters highlighting the technology involved and special “talk-back” sessions and open-ended Q&A after selected performances were used to discuss the interplay of technology and the arts, robots as commonly portrayed in the media, and robotics applications.

II. EXAMPLES OF HOW THE ROBOTS WERE EMPLOYED

One pizza-sized AirRobot 100-b quad-rotor (see Figure 1) and six E-flite palm-sized toy helicopters (see Figures 2 and 5), were inserted as supporting elements into Shakespeare’s play. The play is written about humans (Duke Theseus of Athens, Queen Hippolyta of the Amazons, Athenian teenagers, a theatre troupe) and spirits (Fairy King Oberon and Queen Titania, each with an entourage of human fairies). The unmanned vehicles supplement each entourage. The quad-rotor flew directly above and behind Oberon during his entrance and his exit in the final scene. Queen Titania has five fairies (Moth, Cobweb, Peaseblossom, *etc.*) each of which was paired with a micro-heli.

The robots participated in five of the nine scenes. For example, in Act 2, Scene 2, Titania’s fairies sing as they cocoon her and the micro-helis hover over the action; at the end one fairy remains to guard Titania in her sleep. The intention in this scene was for the micro-helis to complement the enchanted world that Shakespeare created. They hovered above the action and when near a human fairy, that actor would interact with it, establishing what some identified as a mother-baby relationship. The actors learned to interact with the micro-helis in a very convincing manner, improvising petting or cooing to the micro-helis as they landed, or scolding a micro-heli that crashed or was being difficult to catch. By the end of this scene, the relationship between human and baby fairy was crystallized.

For a more complete description of the robots as they pertain to the play itself, we refer the reader to [1].



Fig. 2. Two of the micro-helicopters, yellow and orange costume, can be seen in flight. As Fairy Queen Titania sleeps, the orange fairy (house right) delivers the line “Hence, away! now all is well: One aloof stand sentinel.” At this point each of the four fairies on the left catch their respective mini-fairy micro-helis and march off showing an attitude of displeasure (sticking a tongue out at the orange fairy). Occasionally some hijinks would ensue as the helicopters resist capture and the orange fairy gets increasingly irate.

III. ROBOTS AND TECHNOLOGY AS INTEGRAL PARTS OF THE PRODUCTION

The primary (and critical) theoretical question was whether robots would hinder or help the audience experience of *A Midsummer Night’s Dream*. It is conceivable that the novelty of robots, for example, would distract and hence detract from the story, the performance of the main characters, or the overall experience of the play. Until the public preview of the play itself, we were uncertain how the audience would respond to the robot fairies in their midst (sometimes flying literally over their heads). Despite this underlying uncertainty, the planning, development, rehearsal stages all sought to answer the question of how the human and robot actors interact in a way to give the maximum impact to the characters and the story. Practical and specific questions arose regarding: how to bring the audience into the experience and whether they would accept what they were seeing? What is an appropriate directorial concept incorporating robots? And, how does one link the robots, via design, staging and use of affect, into the production?

The following four subsections present decisions that were made and approaches taken in order to simultaneously frame the role of robots, and to manage this underlying uncertainty.

A. *Social Actors not Inanimate Props*

An early and important decision is to what social model the robots should portray. It is probably easiest to conceive productions of traditional Western-canon plays that cast the robot as servant or background player. The production hoped to create a robot coterie of social actors, rather than inanimate props. In a sense, provided they contribute to the story itself, this justifies their use as more than technology for technology’s sake. In our production robots did not subsume any roles, yet the integration of the robots into the narrative

of the play made the robots more than props. (This is in contrast to the robotic technology used in *Cymbeline* [3].)

As non-anthropomorphic actors, the robots used physical movement as their primary means of expression. Experimentation with the capabilities of the robots by the operators resulted in three emotive elements that could be reliably and routinely portrayed with the six palm-sized mini-helis:

Happiness A display of happiness from a robot was a slow rotation or bounce in mid-air. We term a rapid change in robot altitude a bounce.

Menace Robots flying with their noses at an extreme downward angle and at a fast rate of speed displayed menace.

Mischief Mischief showed up as a very fast rotation, interspersed with a bounce.

The quad-rotor, fairy minion of Oberon, was widely regarded as being menacing and “scary.” This was probably to do with its size, the down wash from the robots, and the noise it made. Artistically, it was prohibitively loud and was given a limited presence otherwise an actor’s lines were hard to hear without disturbing the pace of the action. The small stage area and close seating meant that the robot had only a few safe lines to fly without being directly over the audience or an actor and had a tiny landing area.

The micro-helis did not have this limitation and frequently flew over the heads of the audience during the action. They were initially launched from a rear row of seats and flew to the stage itself. In this way, flying robots were able to extend the space in which the drama took place to actually encompass the audience physically.

B. Adding new scenes

Three additional scenes were added to the play:

1) *Prologue*: The production opened with a prologue dance number, featuring all the fairies, both human and robot. For this prologue, the human fairies (eleven in total) and robot fairies (six in total) entered in groups from backstage and through the audience, dancing to original music. The intention of this addition was to introduce the audience to the robots in a way that does not stop plot action. Including this prologue dance number brought the audience into the world of the play, and the inclusion in that world of supernatural fairy characters, both human and mechanized. The music itself had electronic elements, glow sticks and lights on the costumes to emphasize the quasi-futuristic other world.

2) *Mocking of Bottom*: One robot even got a stand-alone scene: at the end of Act 4, Scene 1, Bottom wakes up and leaves the forest to go back to Athens. As he leaves, one of the human fairies and one of the micro-helis come up behind him and mock and laugh at him. Figure 3 shows this.

3) *Curtain call and final dance*: Once the final monologue had been delivered, the cast returned to accept applause and take a bow. The quad-rotor and any available micro-helis were flown back on stage at this point. The quad-rotor would land center stage (which is the only planned landing maneuver of the play). Micro-helis, launched either by robot



Fig. 3. Mustardseed launches her micro-heli from the scaffold; while she is on her haunches the micro-heli takes center stage mocking Bottom (on the edge of the frame to the left) using its mischievous wiggle.



Fig. 4. The set, designed by Jean Daniels, was a black floor with a full moon painted center stage, a star drop against the back wall, and two construction scaffolds, distressed to look rusty with age. Photo by Jane Martin.

operators or by fairies (who retained them from the last scene) fly over the stage and interact with the cast.

C. Choice of setting and costumes

The director (Hopper) began by envisioning the forest as a fairy “otherworld” as it needed to accommodate futuristic robots, immortal fairies, a love quadrangle, blue-collar yahoos and ancient mythological heroes, giving the play a timeless quality, outside of a set historical period. This concept translated into three aspects: a minimalist set, technology-heavy costume design, and sci-fi inspired sounds.

1) *The Set*: The set (shown in Figure 4) embodies this same timelessness: two scaffolds, doctored to be something between rustic-organic and futurist-synthetic also allow for easy reconfiguration as the action changes. The figure shows how Titania’s fairies hide in the “forest” whilst overhearing the conversation.

2) *Sounds*: The otherworld concept resulted in a sound design that used video-game controllers to create a live

sound-scape for the fairy world. Jeff Morris supervised sound design and technology. His solution for linking the human and robot fairies via sound appeared in the form of Wiimotes, the video game controllers that sense and react to human movement. The Wiimotes provided the opportunity to create sound, generated by the actor, amplified to sound robotic, thus aurally linking the human and robot fairies. The sound team installed a visible Wiimote on Puck's broom, which Puck used as a magic wand: turning Bottom into a donkey, creating fog to disorient the lovers, *etc.* As Puck moved the broom off its vertical axis, it created an electronic swoosh sound that could speed up or slow down, depending on how fast the broom moved through space (the result was an evocative sound similar to the sound shifts in the humming of a light saber in *Star Wars*).

3) *Designing Costumes for Humans and Robots*: The concept translated into a technology-heavy costume design (costumes incorporate high-tech elements LEDs, light ribbons, fiber optic fibers, metallic jewelry). Costume and lighting designer Autumn Casey needed a way to place the micro-helis clearly in the world of the play as fairies, and not just as flying helicopter-sized toys. She also needed to differentiate each member of the robot hive and connect them by color to a corresponding human actor. See Figure 5.

The most obvious example of this linkage used differently colored fiber optic lights in the human fairy costumes—in the trim detail on a skirt, the lining of a hooded sweatshirt, in the folds of a ruffle or worked into a wig. The fiber optics in the human costumes mirrored the micro-helis' own LED light at the front of their internal structure; however, the micro-helis were more problematic in their costuming. Their internal structure could only hold so many ounces of weight before they were unable to lift off.

The solution to the problem of costuming the micro-helis, discovered after several attempts, was in constructing a shell, about two inches wide by eight inches long, of plain white cardstock. The shell had a metal snap closure at both ends, to facilitate its placement on, and removal from, the robot. Attached to the outward facing side of the cardstock was crumpled colored cellophane. The cardstock had a hole placed so that it matched up with the micro-heli LED. This light illuminated the cellophane and made the robots glow, which made them visible to the actors, audience and pilots.

The costume designs and sound were responsible for the majority of the visual linking between human and robot actor.

D. Visible controllers

The quad-rotor's pilot stood in the house-left vom, part of which also served as the robots launch pad. The Micro-Heli pilots sat in chairs in a row directly above the house right audience seating. No attempt was made to obscure the relationship between the micro-helis and operators throughout the play, the curtain call was the only time the robot operators and their role was explicitly acknowledged. Most performances resulted in the audience showing their appreciation by applauding while facing the pilots.



Fig. 5. The fairies and micro-helis. Note that the green fairy has a yellow-costumed micro-heli in her left hand. Photo by Jane Martin.



Fig. 6. Oberon and Puck. Note the white Wiimote taped at the bottom of Puck's broom handle. Oberon's cuff bracelet was originally intended for the same purpose. Puck's shirt has a sequence of bars which react to the ambient sound; her motion of the broom generates sound through the sound system and automatically produces visual cues that are synchronized and associated directly with her motion. Photo by Jane Martin.

Positions of the pilots were determined largely by operational constraints: the pilots needed to see their robot in order to fly it successfully keeping it away as best as possible from people, lighting instruments, set pieces and large air conditioning vents. Of course, visible pilots are nothing new to contemporary theatre—audiences easily reconcile the performances they are watching with the visibility of puppeteers in the musicals *Avenue Q*, *The Lion King*, or *Finding Nemo*.

In a similar vein, securing the Wiimote used for generating whooshing noises by Puck did not work and camouflaging it on the broom handle only seemed to make it more obvious. The decision was made at logistic and aesthetic levels to leave it out in plain sight. This can be seen in Figure 6.

IV. PARTICIPATION IN THE DRAMATIC PROCESS

Robin Murphy first proposed collaboration between CSE and Performance Studies in January 2009, as a way to help her graduate students become better at understanding extremes of human emotion, which in turn, would lead them

to better replicate those emotions as affect in robots. At that point *Midsummer* was already programmed for the Fall 2009 season. From that initial conversation, the CSE team joined the production and two or more from their group attended every production meeting from the first in August 2009 to the post-mortem in November 2009.

During rehearsals, robots were incorporated into staging and choreography the same as the actors; robot crew received character notes about the affect best needed for any given scene. The group of robots and pilots were managed just like other self-contained elements of cast. For example, some meetings involved rehearsal of only the Athenian wedding party, and neither fairies nor robot flyers were needed. Just as the director evaluates the capabilities of her actors, she assessed what was feasible with the robots and this progressed throughout the process.

Each actor playing one of Titania's fairies was responsibility for her micro-heli during the performance. She made sure their robot got on and off stage at the right time, and, if necessary, retrieved their robot from the audience. The human actors interacted with their robots on a personal level and this was crucial as it maintained a degree of levity about the whole matter. In Figure 5 the green fairy (Moth) is being greedy by attempting to catch the blue fairy's (Mustardseed) mini-heli; whenever she manages, there is a bit of a play tussle between them as they each try to get their own micro-heli back. If a crash struck an actor or became entangled in a costume or wig, the nearest human fairy might extract the micro-heli and mime scolding it. Sometimes a micro-heli simply crashed to the stage and a human fairy would pick it up, usually with exaggerated gentleness, and stroke or coo over it as it is were a bruised bird or child, then hold it up to let the operator attempt to relaunch and resume hovering. When the operator did not spin up the rotors or if it were the second crash in a row (the operator presumed a mechanical failure and would not attempt flight again for fear of distracting from the play), the human fairy would just cuddle the robot as she continue her role.

One important difference, however, between the flyers and other parts of the cast was that the team of pilots had a degree redundancy. The range of skill was quite varied and this would be reflected on the number of crash landings in a given performance. While we did not institute an "understudy" mechanism of the pilots, we did have to address a comparatively high failure rate of the hardware. The micro-heli costumes were interchangeable and a small set of extra uncostumed helis where kept in reserve. After a crash landing which damaged the rotor (or, more usually, rotorshaft), the fairy responsible would pass the robot back (via a properties manager) to the flyers. Usually the costume was exchanged via the snap closure to be placed on a new identical mini-heli. Some hardware work was involved keeping a stock of operational helis, and one team member treated this as his primary task. In fact, some repairs were needed to some of the other electronic costume elements (*e.g.*, Puck's costume) and the roboticists assumed the role.

V. CONCLUSION

Although our 2009 production of *Midsummer* was a success, it was not clear from the outset that it would be. There was a great deal of uncertainty around whether the robots would contribute to the play itself, or merely feel like a superfluous gimmick. This is likely to be a concern for other productions and some time still to come, since we are certainly still in the period of early adoption of robotic technology for theatre.

Although we can not say that techniques employed in *Midsummer* will apply everywhere, they point to some ideas which could be constructive for future productions:

- If possible, identify what the social model is intended for the robots. Are they to be social actors, or mechanical elements of the scene, or autonomous props? Are the robots playing robots, or other social elements?
- A context which was open to "other" creatures, in this case the enchanted world that Shakespeare created, helped smooth boundaries between the robots co-actors and actors themselves. Is discontinuity desired?
- Robustness of the performance to hardware failures and pilot error had a great deal to do with: (a) the flexibility and skill of the human fairies; (b) the arrangement which had a dedicated actor responsible for each robot; (c) the possibility and ability to turn robot foibles into part of the humour.
- Costume design for robots must be considered very carefully. They must satisfy the constraints of human costumes and several others too.



Fig. 7. Part of the cast posing with the robots.

REFERENCES

- [1] R. Murphy, D. A. Shell, A. Hopper, B. Duncan, B. Fine, K. Pratt, and T. Zourntos, "A Midsummer Nights Dream (with Flying Robots)," *Autonomous Robots*, vol. 30, no. 2, pp. 143–156, Feb. 2010.
- [2] *A Midsummer Night's Dream: Social Proof in HRI*, Osaka, Japan, Mar. 2010, late-breaking report.
- [3] P. Ruggiero, "Shakespeare's *Cymbeline* is a machine of sorts —or so proposes Quantum Theatre," *Pittsburgh City Paper*, July 31 2008.