

# ToyBox Futuristi: An Expression of Futurism via Digital Puppetry

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## ABSTRACT

ToyBox Futuristi is a digital puppeteering toolkit created by a student team from Carnegie Mellon University's Entertainment Technology Center (known from this point forward as ETC). The team took its inspiration from the work of Italian Futurist Fortunato Depero, in particular *Balli Plastici*, the 'plastic dance' he created in 1918. Depero's marionettes encapsulate the Futurist ideal of machinery striving to break free of human control, a theme expanded upon by the use of contemporary technologies. The project was driven by two deliverables: the digital re-imagining of *Balli Plastici*, a version of which was shown at the Performa 09 Arts Festival in New York City, and the development of ToyBox Futuristi, the puppetry software that enables users to create their own versions of the ballet. This paper will focus on the creation of ToyBox Futuristi, including how the creative team took inspiration from the work of Depero and the Futurists while simultaneously establishing a sense of style and functionality adapted to the digital age.

## Keywords

digital puppeteering, balli plastici, futurism, animation, fortunato depero, human-computer interaction, entertainment technology

## 1. INTRODUCTION

In 1918, the Italian Futurist Fortunato Depero created a collection of marionettes and set designs for a production he called *Balli Plastici*. He worked with a variety of composers to arrange existing and new pieces of music for each different act of his show. It was performed eleven times, and though it was considered novel, its reception was lukewarm. Eventually the

puppets were destroyed and were re-created only in 1981. Visitors can visit those same puppets in Casa Depero, the artist's former home in Rovereto, Italy, currently maintained by the Museum of Modern and Contemporary Arts of Trento and Rovereto (MART).

Translating the ancient, hands-on art of puppetry to a digital medium was not a trivial task, but that is exactly what our team of graduate students at the ETC set out to do in just under sixteen weeks. Depero's marionettes were especially ideal for the project due to their vibrant, iconic nature. We also believed that we could, in a sense, be "more Futurist than the Futurists," by which we mean using today's technology to enact the transformations of speed and dynamism that the Futurists wrote about but could not fully embody in their work because of the technology available to them. We maintained a reverence for the Futurists throughout the project, in particular for Depero, but we also reserved the right to make small changes to style and content, as long as they were in keeping with the Futurists' ideals.

To achieve this aesthetic alchemy of past and present, we developed a digital puppetry toolkit and used this software to bring to life our own re-imagining of *Balli Plastici*, which was showcased at the Museum of Arts and Design in New York City as part of the Performa 09 Arts Festival. We then packaged the software for disbursement to audience members from the performance, as well as others, on a non-commercial basis.

## 2. TOYBOX FUTURISTI

We named the software we created ToyBox Futuristi, and it is the end product of a 15-week, interdisciplinary, collaborative effort to bring Depero's marionettes to life in the hands of the general computer user. ToyBox Futuristi is a recreational, virtual toy that

introduces new users to Depero's work and also allows for creative exploration and personal expression. It is a piece of interactive software designed specifically with Futurism and user accessibility in mind.

## 2.1 Design and Implementation

Design responsibilities for the Depero Futuristi team were split among the whole team, and no team member had preference when it came to making design decisions. This is a model that is common among ETC teams and that allows all members of the team to feel ownership of the product, as well as to feel involved in the creative process.

The design focus was to make software that anyone could use to create his or her own version of *Balli Plastici* using Depero's puppets and the original music score. We also sought to make the re-imagining for Performa 09 both entertaining and reminiscent of the Futurist aesthetic, in terms of look, feel, and dynamism.

Early on in the design process, we decided to make the toolkit as widely accessible as possible, in part by focusing on the keyboard and mouse as the primary input devices. If we had developed the software strictly for professional puppeteers, then we would have considered more novel solutions for input. In fact, a previous ETC team had developed a version of the software that used input devices created for Nintendo's Wii gaming system, including the Wiimote and Bluetooth dongle. These controls allowed users to perform realistic puppeteering actions, in terms of mimicking the hand movements required to control a physical marionette. They also, however, added a layer of complexity to the process, by requiring the user to be, or to become, proficient with both motion-oriented controls and a thumbstick. We wanted controls for which the learning curve was not quite as steep, and the universality of a keyboard and mouse system allowed us to make two key assumptions: first, that most households would already contain a keyboard and mouse, and, second, that most owners would be proficient in using them.

We also considered very carefully the question of the on-screen user interface itself and how the UI would complement the input devices. We knew that the UI must be easy to use and understand while, ideally, also requiring some skill to master. An easy-to-use UI means quick, positive feedback for anyone new to the software, which we thought necessary as a way to generate initial interest in the product. Additionally, having an interface that it takes time to master increases the 'stickiness' of the software in terms of making a significant time investment a rewarding experience and inviting replay.

The UI for puppet control that the team decided to implement was inspired by another ETC project called "Quasi." [1] Quasi is a robotic puppet whose movements are dictated by a touchscreen interface that graphically represents different emotional states. Using a stylus to drag a circular marker around a geometrical shape, an operator gets to choose Quasi's actions and reactions without having to physically manipulate the puppet.

For ToyBox Futuristi, we adapted the look of Quasi's puppeteering UI to our own needs and simplified the controls to include four basic actions for every puppet. When clicking on the "Action" tab of the UI, the user sees a 2D map consisting of a circle, within which lies a smaller circular marker. The larger circle is broken into four quadrants, and a distinct animation is assigned to each axis. Moving the marker between axes results in

the blending of those animations; this means that the user is able to control for different discreet animations plus the variation in blending between animations by positioning the marker within the circle. Additionally, moving the marker farther from the center of the circle causes the animations to play faster, while moving it closer to the center causes the animation to play slower. By using the mouse to drag the marker anywhere within the circle, the user can control both the nature of the puppet's movements and the speed at which it animates. The puppet's position on the virtual stage is controlled using the keyboard's arrow keys, and the speed of movement in 3D space is proportional to the animation speed. Making these decisions formed a solid foundation for the software that allowed the team to focus on accessibility and ease of use throughout the development cycle.

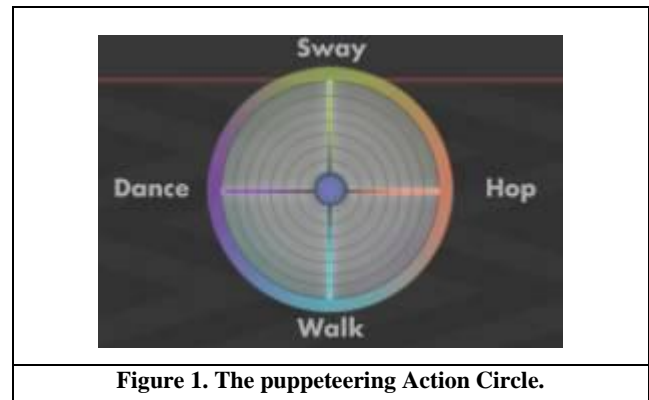
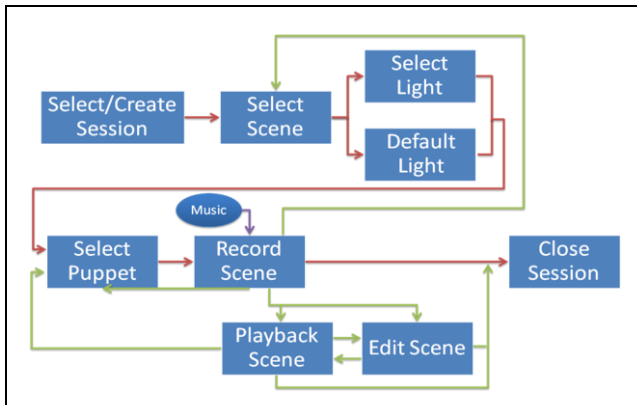


Figure 1. The puppeteering Action Circle.

As the software began to take shape, we shifted gears and imagined the product in its completed state. With only one semester in which to develop the finished product, we knew it would be out of the project's scope to make the software a full-featured editing or animation package like Adobe Premiere or 3D Studio Max. Additionally, we felt that offering this level of minute detail and adjustment would introduce an extremely steep learning curve that would decrease the accessibility upon which we based the software design. We realized that it was better to focus on the puppetry toolkit as a *toy* rather than a *tool*. Thinking of the software as a toy brought our attention back to the concepts of simplicity, ease-of-use, and entertainment for its own sake. This distinction helped to focus the design on avoiding guest frustration and on emphasizing Depero's humor and visual freshness.

When we were using early versions of the software to create the animation for the performance in New York, any feature that was needed repeatedly during the recording sessions was coded into the toolkit and later implemented in the final version. This meant that our team – as a developer – was using the toolkit to create the same sort of experience that we expected our end users to be able to create. This approach helped to make intuitive software that contained the features that would be useful for the users. The diagram below shows the complete process of recording a scene using ToyBox Futuristi:



**Figure 2. Insert caption to place caption below figure.**

The red lines represent the mandatory actions and the green lines represent the optional actions. The oval box represents input from the Software and the rectangle boxes are the different stages of the software. If the user traverses the red path, he will be able to create a basic scene. The user starts by selecting a session that is in the database or by creating a new one. Choosing a scene to record is the next step. Here, the user can also preview the music. Different lighting setups are available for selection; otherwise the default light will be set for the scene. After a puppet is selected, the software enters the recording stage where the music for the scene is preloaded and played back as the recording is taking place. Now the user has a choice: go back to the Select Puppet step and record another puppet for the scene or go to playback and see what has already been recorded. The user can then also edit the scene and return to playback or simply end the session.

## 2.2 Art Style

Fortunato Depero's work has a very distinct style, with hard edge lines, colors and a strong sense of dynamism. The style is simple and iconic, and appealed to a wide range of people across many types of media, which fit perfectly with the aim of our project. His work still appears fresh to the 21<sup>st</sup> century audience; there was no 'updating' of the style per se, rather it was a process of merging our artistic views together

While the original marionettes no longer exist, we did have the opportunity to visit recreations of the puppets from a 1981 production (which are, as mentioned previously, housed in Rovereto, Italy). The photographic and video documentation we made of the puppets and their articulations aided us in digitally modeling the puppets as accurately as possible, so that the digital version possessed movement capabilities very true to their physical counterparts. Exceptions include modifications made to the Hen and Cat puppets, which were given expressive movements to convey emotions that were called for by Franco Sciannameo, our director, but would not have been possible with the original wooden puppets. Based on our research into Depero's views on art, technology and Futurism, we felt justified in making these slight alterations designed to enhance emotion and storytelling. Using technology that Depero could only have dreamed about in his day, any changes we made to the artist's original designs were entirely inspired by his vision and by Futurism itself.



**Figure 3. Virtual models based on Depero's marionettes.**

After researching *Balli Plastici*, we found paintings of several set pieces that were used in the original production. At Professor Sciannameo's suggestion, we recreated some of them, including the floral piece and the sun in Acts I and III. Other ideas came straight from the 1981 reproduction of the ballet, such as the use of midpanels and butterflies. We also created several new backdrops specifically for this project. For those, we received a vague setting of each scene from our director, and the rest was up to us to interpret and design with the look that worked with Depero's puppets. Again, Depero was our inspiration throughout.



**Figure 4. Recreation of original set, used in Act III.**



**Figure 5. New style interpretation, used in Act I.**



**Figure 6. New style interpretation, used in Act IV.**

The user interface design is highly functional and user friendly in appearance, and, as we discovered through user testing, is not age-specific in its appeal. We applied Depero’s style of work, if not his original designs, to the look and feel of the UI in hopes that this would be a good opportunity to introduce his work and Futurism to anyone using ToyBox Futuristi. All of these artistic decisions are at the service of usability and, instead of being overpowering, are purposefully designed to enhance the user experience, accentuating the software features in a way that is consistent with the desired experience flow.

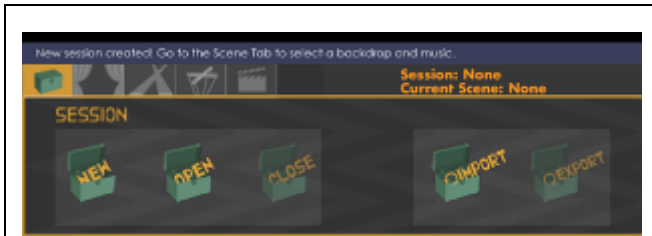


Figure 7. The “Session” Tab.

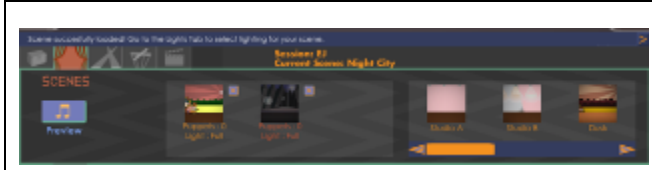


Figure 8. The “Scene” Tab.

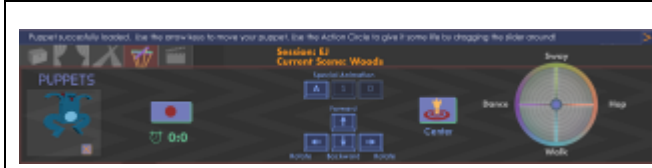


Figure 9. The “Action” Tab.



Figure 10. The “Director” Tab.

### 2.3 Technical Overview

The software was created using the scripting language Python and Panda3D, a prototyping, open source 3D engine created and used by Disney [2]. The use of this engine facilitated the implementation of 3D models that closely matched the original puppets and allowed manipulation of their various movements. Autodesk 3D Studio Max and Maya were used to create the models and animations of the puppets as well as environments

that were used in ToyBox Futuristi (for example, the virtual stage). The use of shaders allowed us to add lighting effects like shadows, which enabled a more believable stage environment. The software development was done in approximately 14 weeks, using the codebase from a previous ETC project. We stored data using a SQLite database and distribution of the software was aided by the use of the PackPanda installer tool.

The architecture of the software consists of several modules that manage the assets, the user interface and the management of inputs and the recording and playback. We kept our components very object oriented - in order to control the different common elements more efficiently, such as the user interface or the puppets and environments - and used notifications to have the different objects interact with each other. That allowed us to have a very responsive user interface based on the inputs of the user. For example, we have a graphical representation of the arrow keys that respond when the user presses the keys. That gives two levels of feedback: one to guide the user to use the keyboard, and the second one to make the user aware that his actions are influencing the actions in the screen.

### 2.4 User Testing

One of the main goals behind the creation of ToyBox Futuristi was that we wanted it to be highly usable while also being a piece of art in itself. To help us reach this goal, we tested the software with people who had never used it before, and then asked them questions designed to elicit specific information about their experiences. The process revealed important insights about the most and least enjoyable aspects of the product. For example, people were fascinated by the range of puppet movements, but frustrated by having to go backwards in the program to use certain features.

Another goal was that we wanted the user experience to be fun. We conducted a test focused on youth and adults from age 12 and higher, and again used a questionnaire with specific questions relating to the fun nature of the product. Both the children and adults enjoyed the tool in terms of the creative exploration the software offered. They also treated it more as a toy than a tool, which fulfilled our original intention.

Armed with feedback of this nature, we were able to improve the flow of the user experience dramatically and implement new features – such as a hint system and graphical representations of keyboard controls – that made the software much more visually appealing, fun to use, and accessible. After user testing, some of the aspects of our design that were most often praised by visitors and testers were the user interface, general software flow, and the polished appearance of the toolkit.

### 3. PROJECT CHALLENGES

First, and perhaps most obvious, was the recognition that there was a true disconnect between physically handling marionettes – feeling their size and weight, as well as learning the skills to move them – and manipulating digital marionettes. While this project was not an attempt to replace the awe-inspiring craft of puppetry with a digital facsimile, it would have been ideal to somehow communicate more effectively the physical aspect of handling Depero’s puppets. Our team visited the collection of puppets in Rovereto, Italy, to better acquaint ourselves with the marionettes’ sizes, shapes and articulations. This research proved crucial to translating the puppets’ physical forms into digital means. In our attempts to make the software widely available and usable by

many different people, however, options for physical interfaces that emulated a true marionette cross control were extremely limited. The best we could hope for was to simulate the results of a puppeteer's actions.

To this end, we tackled the challenge of communicating personality and emotion through the puppets. Having had a chance to examine the re-built puppets from 1981, we found that the marionettes had quite limited ranges of motion, with many lacking knee or elbow joints. This knowledge was a double-edged sword in that it made us more aware of the puppets' unique anatomies, but it also made them more difficult to animate digitally. Accordingly, while we replicated the puppets as accurately as possible, we also took advantage of the digital medium to modify them. One of the best examples is that the virtual Hen marionette is capable of moving at the hips, where there was no joint in the physical incarnation. Also, the digital Hen can actually puff out its chest, changing its own profile. In this subtle manner, we looked for ways to increase the puppets' personalities and ranges of motion, though mostly by staying true to the original anatomical structures. These modifications became part of the user's experience, in that they added slightly more movement options when creating recordings. By looking for ways to take advantage of the digital environment, we hoped to enable better storytelling.

We realized early in the semester that without a team of dedicated modelers and animators, we couldn't possibly create a full-length animated movie, which was a big factor in the decision – mentioned previously – to use our own software deliverable to create the re-imagining *Balli Plastici*. This allowed us to balance the workload using our interdisciplinary skills. Our animator could focus on creating only the looping and special animations needed for the software, which in turn were the things needed for the creation of *Balli Plastici*. The modeling process was also made easier by a plethora of first-hand reference material made available by the team's trip to Italy.

While working towards the Performa 09 deliverable, we wrestled with how best to tell a story using Depero's puppets. Futurism is known for breaking traditional boundaries and structure in the arts, including plot structure in theater. *Balli Plastici* was no exception, consisting of a variety of unrelated scenes and unexplained events - for example, a rain of cigarettes. While we had the benefit of a choreographer who had studied Depero's notes (and who was also our client for the Performa showcase), we still wanted to make sure that the end users would be capable of creating stories of their own, and doing so with comfort and confidence. The design of the software itself went a long way to remedying this: the software was easy to use and allowed users to get results quickly; it allowed users to play with Depero's puppets and get a feeling for their character; and the ability to blend the puppet movements and change animation speed helped to create a variety of movements to supplement stories.

#### 4. PROJECT RESULTS

The way in which the software evolved was critical for the project development; it helped us finish on time and keep the list of software features within a realistic scope. We found the following process to be very helpful: we started by creating a fully functional version of the software and eventually finalizing the

shippable version by adding user interface and stylistic changes gleaned from user testing. The first decisions made regarding the software were concerning low-level programming issues like choice of 3D engine, lighting methods, control mechanisms and database management. After building the base for the software, the basic user experience flow was determined so as to set a structure for the asset and programming pipelines. With the skeleton of the software built, the programming team was split in two. One sub-team focused on the recording of the performance, database management and implementation of quick features while the second sub-team focused on the implementation of permanent features, support features for the first sub-team and UI. After the New York performance all of the programming efforts were targeted toward usability, resulting in the implementation of features that aided the users in easily recording and modifying their own puppeteering scenes.

In addition to the software, the performance in New York drew about 80 attendees, and we did a live demonstration of the software used to create the show, which led into a question-and-answer session. The crowd was very interested in the work and asked very well-informed questions about the software and its future. We found that showing the software at Performa spurred the timely creation and implementation of features and user interface design. After the performance, we focused on user testing and polishing the software. Armed with valuable user feedback, the software underwent – in a matter of weeks – changes that made it easier to use and more engaging. Finally, we were able to package the software on a DVD with a variety of instructional materials, as well as the re-imagining of *Balli Plastici* itself.

Perhaps most importantly, we were able to lay a foundation for the future of digital puppetry and discussions thereof by attempting to answer tough questions about the translation of the art through the development of our software.

#### 5. CONCLUSIONS

The aspects that have made ToyBox Futuristi a success, in terms of reaching an audience that enjoys playing with the software, are the results of a solid design process during which every decision was made as a team. Most importantly, every team member shared a vision of what the product should be, and every decision was made in order to fulfill that vision. We split our resources according to our unique interdisciplinary abilities, and were thus able to work on several parts of the final product concurrently. However, we did face some unique challenges in translating puppetry to a digital format, and also in keeping the vision of the original artist, Fortunato Depero, intact. We think he would be happy with our product, and ToyBox Futuristi would not have been possible without him as a constant source of inspiration.

#### 6. REFERENCES

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