**Project 1: Literature and Product Review**

Advanced Animatronics for Entertainment

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When you think of your fondest memories as a child, most will think about the spent with friends and family while indulging in some form of entertainment. This entertainment can be live shows, watching movies, or visiting an amusement park. Take moment to think about your favorite type of entertainment: Is it a sci-fi movie series like Star Wars? Perhaps a theme park like Disney World? When you imagine these forms of entertainment, so many of them would not be able to come to life without the use of animatronics, the entertainment industry “puppets”.

Animatronics can be thought of as a mechanical figurine or a life-like robot. They can be created using pneumatics, hydraulics, electrical controllers, and/or programmed computer software. What differentiates an animatronic from a robot that you may see at somewhere like Boston Dynamics is that an animatronic typically brings a specific character or person to life by replicating their features, movement, and speech. The purpose and impact of animatronics in the entertainment industry are driven by this ability to bring characters to life. The entertainment industry is a special aspect of many lives and creates a societal impact that may not be seen by everyone, but is necessary to survive. When you think about how to wind down after a long day of work, or how to escape the stress of reality, typical responses are to turn on one’s favorite movie or TV show and step into another world. In some instances, people will go to theme parks like Disney or Universal to physically step into a world that has been brought to life. Everyone is a dreamer; whether you are a young child just learning how to walk or a someone who has been working in the industry for over 30 years, we are all children at heart that need the small things to keep us happy and bring us joy. Technology is a beautiful tool that, as it becomes more advanced, helps create more life-like experiences and memories for people through entertainment. I strongly believe that in order to fully contribute to society and make the world a better place, we must be able to find things that bring us joy and happiness along the way and escape from our day-to-day lives once in a while. The technological advancements in animatronics have enhanced these experiences, and will continue to do so as technology develops more.

How Stuff Works[[1]](#footnote-1) dives into the details of animatronic functionality by focusing on the Spinosaurus, the largest animatronic creature, for the production of the Jurassic Park III movie released in 2001. The Spinosaurus measures 43.5 feet in length at 24,000 pounds, powered completely through hydraulics and remote-controllers. After the initial stages of preliminary sketching and miniature scale modeling, the model is scanned using a 3D computer-aided manufacturing machine, or CAM. CAM uses software and controls to automate the manufacturing process by laying out the tools and procedures necessary to generate the product. This process is then performed through CNC-sculping, where the model is divided and manufactured in chunks that are then assembles together. Assembling the different chunks is then broken up into different modules, one of which is electronics. The animatronic designers typically create a custom circuit board to control the animatronics by remote-control systems called telemetry devices. The controls are tested out both before and after assembly. These so called “puppeteers” will design, program, and test to ensure the details of the creature are exact, from something as large as an arm movement to as small as a facial expression. Through the remote control, the telemetry device sends the control signal to the circuit board that is wired to the mechanical components.

The basic technology behind how animatronics are created remains the same, yet the animatronics have evolved drastically over time. The Walt Disney Company began developing animatronics in 1961 for film and theme parks. The first animatronic shown to the public was in 1963, where Disneyland created animatronic birds for their Enchanted Tiki Room show. In that same year, for the Hall of Presidents ride, Disney created the first human animatronic figure of Abraham Lincoln, and the creation continued through various theme parks. Animatronics began being used for movies as well, with an animatronic bird in Mary Poppins in 1964, to a full-size t-rex in 1993 for Jurassic Park. More recently, in 2008, Disney created a Mr. Potato Head for their Toy Story Mania! ride with the greatest range of movement of any audio-animatronic in that time.

Disney in particular has taken animatronics to a new level recently, with their research and development in sentient robots. This will take guest experience to a new level with more interaction, by programming sensors and cameras to interact with guests in real time based on the guest responses and gestures. Disney Imagineer, Jon Snoddy, states that the animatronics are reaching a level of intelligence that makes them more believable[[2]](#footnote-2). Disney Imagineering research recently created an animatronic creation of Groot, the Guardians of the Galaxy character, that could walk, talk, and interact with those around it. In June of this year, Disney’s animatronic company advanced forward even more with their WEB Slingers Spider-Man ride in Disneyland’s California Adventure, that not only included a ride vehicle that allowed guests to “shoot webs” themselves using sensors, but also had a “stuntronic” robot show where the robot performs tricks in the air, catapulting over 65 feet in the air and autonomously adjusting its trajectory. The robot was so realistic in the execution that it is hard to tell whether it is a robot or a human. The robot includes 95 pounds of microprocessors as well as gyroscopes and accelerometers. What distinguishes animatronics today from those before are the technological advancements in cameras, sensors, and software to allow these robots to convey human movement.

With this “stuntronic” robot being recently released, there is not much to find on how these technologies actually work. However, Disney’s Hybrid A1000 animatronics are known to differ from original ones in that they have electric movement, allowing for more control and design. Disney Research & Development continues to develop their A1000 models, like Groot, to further the guest interaction. This development used many patentable inventions, such as the self-balancing capable robot actor, with the current assignee as Disney Enterprises Inc. With this patent, the robot is created to have a torso consisting of the battery, CPU, motor control, balance control, and wireless transceiver. Transmission, actuation, and sensing occupy the rest of the body to generate the necessary movements. The CPU and control module are connected to I/Os where software signals are sent to implement the actuation of the body parts or gestures. The controller is also responsible for determining the mood or emotion to be portrayed by this robot. The input comes from the physical space, being from the sensors and cameras in the head by interacting with a guest or from the floor around it, and sequentially selecting one of various different gestures and movement to retain the balance in the physical space. The controller also works without an input signal to provide movements for sets of gestures. Another advancement this robot has is the minimization of components and wiring, using circuit boards joining by integrated flex cabling and mounted to the limbs of the robot. Unlike before where generic actuators were used in many animatronic, there were none that existed to perform the capabilities necessary to bring this character to life, encouraging the team to build their own from scratch, where the actuators apply torque while also have sensing capabilities. The custom software and various gestures to choose from gives these characters a “personality” rather than a fixed set of movements that repeat on a loop.

The Walt Disney Corporation has and continues to lead in animatronics. When there is a new technology in animatronics, such as the sentient robot or “stuntronic”, Disney is the first to unveil it, with other companies following as the technology becomes more readily available. It is unclear whether other film and entertainment companies are using their own research and solutions to create next generation animatronics, solely because the work Disney is performing is already at the next level. Animatronics is an interesting field because it is not a problem of finding different solutions, but finding new ways to approach new problems. For this reason, I believe other companies have taken what Disney has researched and developed it in their own ways to enhance their own experience. However, many individuals are taking to their own opensource projects to develop their own animatronics. The animatronics are on a much smaller scale than those that Disney creates, however it enhances the interest and curiosity surrounding the topic. In one instance, a user on an Arduino forum discussed the start of an open source animatronic animator software for a project to create their own animatronic. In another example, an entire website, called Poppy Project, was created as a community for all people of all expertise levels to come together and learn the power and future of robotics. The trend for all of these forums that are specific to animatronics, however, is that they are dated from years ago and have yet to be touched. Because there is so much proprietary information when it comes to animatronics, Disney included, it is hard to re-create results and products on our own. Websites like Poppy Project, however, can help understand robotics better and, hopefully, robotics in the entertainment industry. In addition, websites like the Stan Winston School of Character Arts allows anyone to enroll in classes to learn about how these mechanics are created and designed, allowing for more education in the area.

While animatronics have had a wide impact on guest experience in many ways, particularly within the Disney Company, the rate of success is sometimes unclear based on the world we live in. The animatronic of a former president making the same small hand gestures over and over may have wowed guests decades ago, but today’s children are growing up in a different world, where cell phones, technology and new ways of living are the norm. Technology like computer-generated imagery, or CGI, uses computer graphics for tv shows, movies, and commercials. While companies like Disney use and develop CGI for their films and movies, it adds an additional layer of pressure to their animatronics to be more convincing and allow for a different experience than a computer-generated image can. While some may argue that animatronics will become obsolete based on CGI advancements, “there is still no comparison to having an animatronic…they can occupy the same space as the actors in a film and impact their environment more than any collection of pixels, however realistically rendered.”[[3]](#footnote-3) The evolution of animatronics has not stopped and won’t stop, for the usage is expanding beyond the entertainment industry, and having other societal impacts, such as in military training and the medical field. Some instances are using animatronics to test military equipment, such as protective suits to be used for armed forces. There is something special about having a robot that encompasses realistic behaviors and gestures, both for entertainment and industry application. While one company may be monopolizing animatronics right now, hindering independent research, I believe this field will continue prosper over time.

**Resources:**

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1. <https://entertainment.howstuffworks.com/animatronic.htm> [↑](#footnote-ref-1)
2. <https://www.nytimes.com/2021/08/19/business/media/disney-parks-robots.html> [↑](#footnote-ref-2)
3. <https://www.stanwinstonschool.com/blog/animatronics-world-review> [↑](#footnote-ref-3)