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How Three Students Utilized CAD, GD&T and 3D Printing to Create a SpongeBob Push Puppet

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Abstract

In this project, three students used Solidworks to design a SpongeBob push puppet. They utilized GD&T (Geometric Dimensioning and Tolerancing) principles to ensure the precision and accuracy of their design. Once the design was completed, they used Makerbot 3D printers to bring their creation to life. The resulting SpongeBob push puppet was a fun and functional toy that demonstrated students' proficiency in using these powerful design and manufacturing tools.

The use of computer-aided design (CAD) software and 3D printing technologies has become increasingly popular in the field of engineering in recent years. These tools enable engineers to quickly and accurately prototype and manufacture complex parts and assemblies. In this project, three engineering students at Millersville University utilized Solidworks, a 3D modeling software used to design parts, GD&T, and Makerbot 3D printers to construct a SpongeBob push puppet. The project was originally assigned for AENG 342: Computer Aided Engineering Drawing, a class where students learn the basics of Engineering Design and GD&T and prove understanding of the concepts of using Solidworks and correct GD&T and Makerbot 3D printers.

The design process for the SpongeBob push puppet began with a variety of concept sketches of parts on paper and in Solidworks, which led to the creation of a 3D model in Solidworks. The students utilized reference images of SpongeBob to create a detailed model, including intricate features such as his eyes, teeth, nose, pants, and spatula. Each part was designed to account for resemblance to SpongeBob and properly fit parts.

The next step in the design process involved the use of GD&T. The students utilized GD&T to specify the tolerances and dimensions of critical features of the push puppet, such as the diameter of all the holes and to ensure proper fit between parts.

GD&T enabled students to ensure that the parts would fit together properly and that the push puppet would function as intended.

Once the design was finalized, the students utilized Makerbot 3D printers to produce the various parts of the push puppet. The printing process presented several challenges, including the need for support structures and the occurrence of warping, which means that parts were bent during printing. These obstacles were resolved using a slicing software that was used to calculate the proper supports and conditions to satisfy a proper print. However, students were able to overcome these challenges through experimentation, resulting in successful printing of all parts.

After the various parts of the SpongeBob push puppet were printed, students began the assembly process to bring the figure to life. The various parts, including the body, arms, legs, fishing line, and internal spring, were carefully assembled according to the Solidworks model. Each part was assembled by 8lb fishing line being fed through the top going down through the body until they reached the bottom of the bottom plate.

The completed push puppet was then tested for functionality. The push button was depressed, causing the figure to lose the tension keeping it standing, and when returned to its original position, the figure once again returned to its normal state. The push puppet was also examined for aesthetic quality, including the accuracy of the model and the overall durability of the toy by ensuring that it functioned properly.

The successful construction of a SpongeBob push puppet using Solidworks, GD&T, and Makerbot 3D printers demonstrated the applicability of these technologies in the field of engineering. The project showcased the students' skills in CAD modeling, GD&T, and 3D printing, while producing a functional and aesthetically pleasing toy. The design process involved the use of GD&T to ensure accuracy, and the production process presented several challenges, which the students overcame through trial and error. The completed push puppet was tested for functionality and aesthetic quality, ultimately resulting in a successful project.

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