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Design and Manufacture of Functional Parts Using 3d Printing for Water and Energy Saving

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Abstract

This paper presents the design and manufacture of a functional nozzle that is part of the water fountain system, through the use of 3D printing, which benefits water and energy savings, as well as reducing costs in the purchase of parts and specialized for this type of mechanisms. To do this, several prototypes are made, and the base and final diameter of the nozzle are reinforced, areas where more pressure is exerted by the water conduit, and where they begin to deteriorate the entire system.

Keywords: 3D printing, object design, additive manufacturing, Prusa I3, water fountains.

I. INTRODUCTION

Water fountains offer a panorama of relaxation, harmony and beauty in shopping malls, homes, businesses and educational institutions, but they still consume electricity and water resources, which must be paid for by each of them [1].

This type of system is composed of pumps that drive the water through its conduits, and generate a huge water and energy consumption, hence the importance of good use and savings of all elements of the process. When one of the devices in the fountain fails, it must be replaced as soon as possible. To do this you must first make a national or international quotation, it all depends on the tools or devices to fix, and if you do not have the spare parts should stop the water source or use poor quality materials. That is why 3D printing is occupying spaces that were previously impossible to think, as it allows the manufacture of parts that can become spare parts with a high quality and thus solve the problem in a short time. [2], [3].

3D printing allows the creation of objects using mostly plastic materials, through superimposed layers thanks to the software which is the computer design and the hardware which is the 3D printer [4]. The most commonly used materials are metal, resins or polymers [5], [6]. 3D printing, brings with it the motto, do it yourself, due to its reduced costs and variety of materials, in this way you could create workshops and workshops for your company [7]. This way you could create home workshops very quickly. 3D printing is being used in a general way in teaching-learning activities, in design and engineering subjects, where it is possible to print didactic material [8], where didactic material can be printed for areas such as descriptive geometry, Riemann sums, Riemann sums, Riemann sums, Riemannian sums [9] Riemann sums, Riemann sums, cubes.

In medicine by printing parts that can be used for organs or surgeries, prosthetics and tissue engineering [10], in prosthetics and tissue engineering [11] in visual or ocular health [12]. In the automotive industry, when only a small stock is needed or to create prototypes that can be tested quickly, as well as very complex and unique parts [13], as well as very complex and unique parts [14].

One of the sectors where it has the most impact is as a business plan for advertising [15]. The products that are marketed are as varied as key chains, cell phone covers or replicas of people. The products that are marketed are as varied as key chains, cell phone covers or replicas of people [16]. Turning the business into a personalized marketing, which is growing every day.

3D printing is the future in the design and manufacture of objects, but many times it is used for the manufacture of promotional or didactic objects for games and pedagogy, and not in the functionality of providing services according to the needs of a company, which always ends up looking for external help for the replacement of devices that deteriorate, that is why in this research, it is shown the design and manufacture of a functional piece that helps in the reduction of the hydric and energetic expense for water sources, by means of the manufacture of the nozzles that have the final conduits of pipes of the sources, for it is designed and tested several models, until giving with the suitable prototype, using a printer Prusa I3 and the software Solidworks.

II. METHODOLOGY

First the fountain errors and malfunctioning nozzles were detected, due to increased water and energy costs, as well as hazardous areas due to water falling in undetermined areas. At first glance it appears functional, because all nozzles eject water to the outside (Figure 1).

But they present the following problems observed in Figure 2, which are:

- The nozzles may have a defective outlet opening, so that water flows out in different directions (see yellow lines).
- As the water runs off in different directions, it falls into unpermitted areas so that people cannot sit on the sidewalk or may fall because they are wet.

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Fig.1. Fountain in operation.

Fig. 2. Problems caused by malfunctioning nozzles.

The aforementioned generates as a consequence:

- Increase in the energy bill.
- Loss and increase in water bills.

The cause of the nozzle defect is the power needed to expel the water, so the outlet diameter must be perfect and the nozzle materials are not strong enough to last more than a year.

The solution lies in designing the nozzle by taking the necessary measurements for the correct diameter and manufacturing it by 3D printing, reinforcing the base as well as the end of the part.

The materials and tools used were:

- Solidworks for the design of the part.
- Prusa I3 printer for manufacturing.
- Repetier software for printing.
- Filament for DaVinci with diameter 1.75mm ABS.

The dimensions of the part can be seen in figure 3.

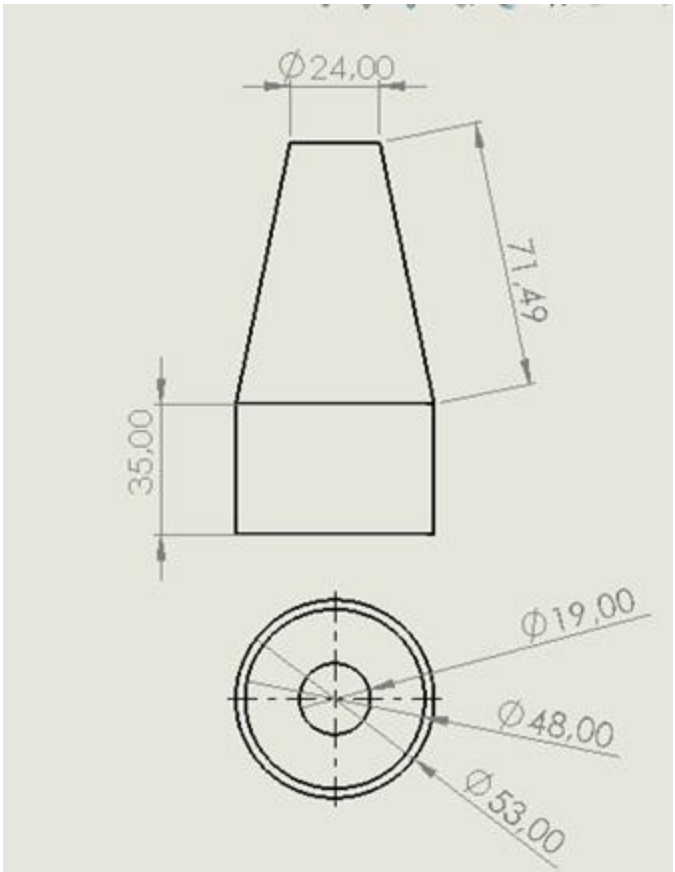

Fig. 3. Nozzle dimensions.

III. RESULTS

First a prototype of the nozzle was designed, selecting the points where it should be reinforced with the base, and final opening, where more layers were printed to reinforce the structure of the part (Figure 4). Which is designed in Solidworks (Figure 5).

Fig. 4. Prototype of the nozzle.

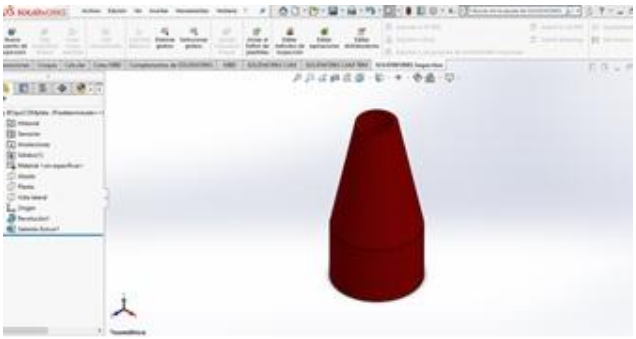

Fig. 5. Design in Solidworks.

Once the prototype of the nozzle is designed, the Repetier software is used to print and control the manufacturing process, which performs a simulation of the process, which can detect errors or deformities in the manufacture, also allows to observe the different layers that will give strength to the piece (Figure 6 and 7).

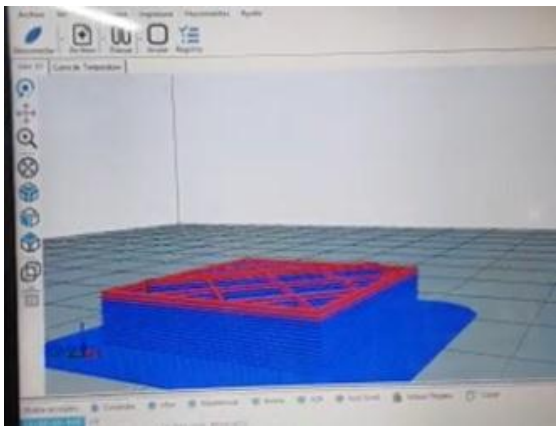

Fig. 6. Simulated impression of the base.

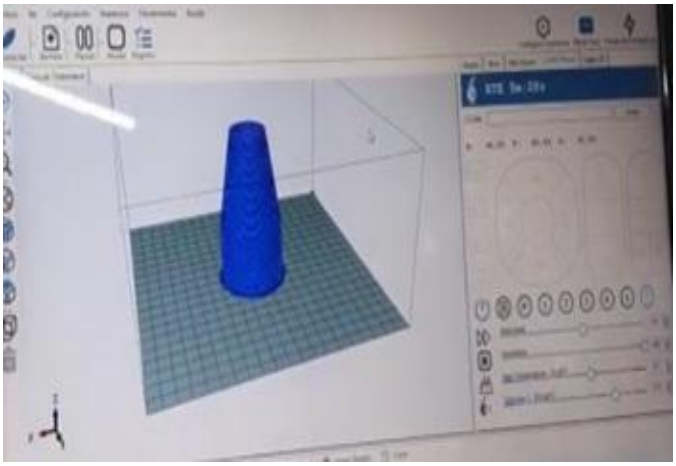

Fig. 7. Simulation of the final impression of the nozzle.

The quality tests are performed manually, that is the advantage of 3D printing, you can reprint the piece, until it is in perfect condition, and the cost is relatively low.

In Figure 8, you can see how the printing of the layers or mesh can determine the quality of it, although it is true that the material is important, so is the configuration with which the nozzles will be printed, a good base with its dimensions, allows it to fit the output tube, and is not dripping, so that the nozzle is not easily ejected.

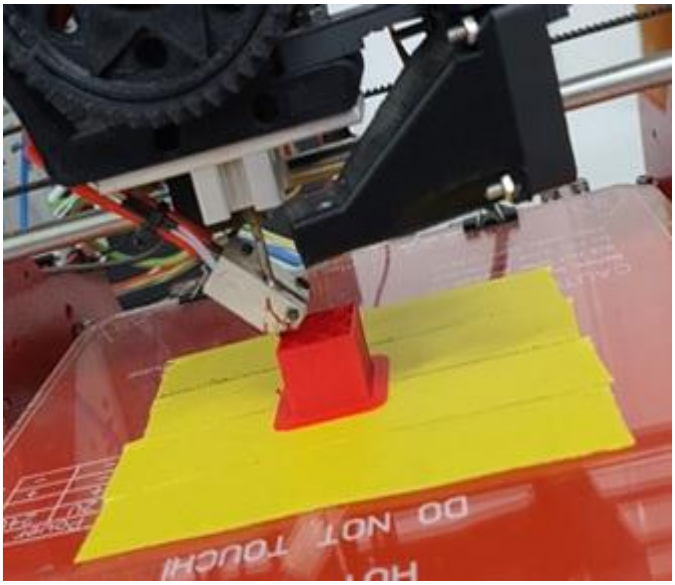

Fig. 8. Impression of the base.

Perhaps the most important area of printing and which must resist the ejection force, is in the exit diameter of the nozzle, the resistance must be maximum (Figure 9), because in this area begins to deteriorate the nozzles that had defects previously, here more layers are printed and a manual force test is done, to look at the deformation of the output.

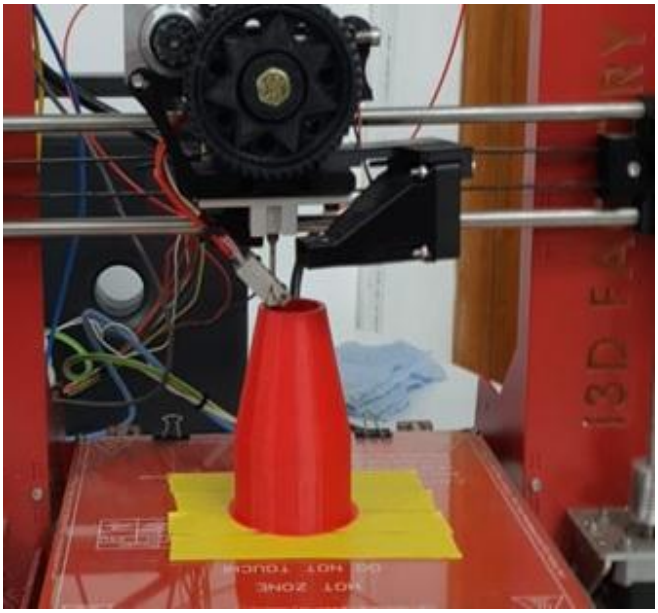

Fig. 9. Outlet nozzle impression.

In Figure 10 and 11 you can see the final piece manufactured and incorporated into the output tubes, the coupling is important to not lose flow or the nozzle is ejected at any time, thus the parts manufactured by 3D printing, offer fast and economical solutions, and are not only used for the development of marketing objects.

Fig. 10. Nozzle coupling.

Fig. 11. Installed and functional part.

The energy and water savings are substantial, and the reduction in the purchase of materials can benefit companies and their spare parts purchasing and storage processes, as different combinations can be made until the most suitable model is found.

IV. CONCLUSION

The design and manufacture of custom parts is one of the most economical and quality alternatives that companies can use for their benefit. The final results when printing the nozzle and coupling it to the piping system, shows that functional parts can be made in a short time, which allow water and energy savings, as well as the reduction of purchases from suppliers, with which companies see a possibility to make more functional parts and not always be focused on the manufacture of advertising objects.

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