ISSN: 2688-8645

Construction of a Quantitative Hybrid Multi-material 3D Printer

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Abstract

This project adopts the method of mixing liquid silica gel on the outside of the printer. By improving the structure of the nozzle of the original 3D printer, the preliminary construction of the quantitative hybrid multi-material 3D printer is completed.

Keywords

Multi-material; Quantitative Hybrid; 3D Printing Technology.

1. Introduction

Also known as additive manufacturing，3D printing technology is a kind of rapid prototyping technology. As an emerging manufacturing method, 3D printing technology has a broad development prospect and bright future in the fields of precision machinery manufacturing, housing construction, biomedicine as well as aerospace. Compared with the 3D printing technology of single material, the quantitative hybrid multi-material 3D printing technology can mix different materials in a certain proportion to meet the requirements of material characteristics. Therefore, the quantitative hybrid multi-material 3D printer has a wider applicability and is of great significance to the improvement of manufacturing technology.

At present, the mainstream 3D printing technology has defects in material applicability, precision control, printing efficiency and waste utilization to varying degrees. And quantitative hybrid multi-material 3D printing technology still has a large room for improvement and development.

2. Process of Improvement

2.1. The Original Plan

The trial construction of hybrid multi-material 3D printer is mainly divided into two parts: programming control and mechanical structure improvement.

In terms of mechanical improvement, the original plan of this project was to design multiple feed ports leading to the mixing room, and mix the materials evenly in the mixing room, and then eject the materials through the nozzle. Then three dimensions of displacement are formed by moving the printer bottom up and down and controlling the left and right and back and forth movement of the nozzle. The typical printer three-axis molding principle is used in this process.

However, in the actual experiment process, we found that there are some defects in the scheme of mixing materials by mixing chamber. On the one hand, the mixing effect of the agitator is not good enough, as the material mixing ratio output from the mixing chamber is deviated. On the other hand, there are attachments on the wall of the mixing room, which causes the staff to open the mixing room for cleaning, otherwise it will affect the next use. At the same time, repeated disassembly and assembly of the mixing chamber is also possible to damage parts. Later, a plurality of syringe pumps were used to inject material to the mixing nozzle to avoid the above

ISSN: 2688-8645

problems. The syringe pump adopts the way of lead screw transmission in the process of motion control, so the motion precision is higher. This is obviously a better way to control.

In terms of programming control, first of all, it is necessary to adjust the running speed and proportion of the two syringe pumps to make them conform to the material ratio required by the model. Secondly, the original printer nozzle motion control program needs to be rewritten, so that the dual nozzle working together into a single mixed nozzle working alone.

In the subsequent experiments, the feasibility of the planned improvement scheme was not high, and a large amount of materials were often left in the hose connected with the syringe pump and printer after the experiment. The residual material in the hose not only takes a lot of time to clean, but may condense on the hose wall if not cleaned in time. Therefore, the connecting hose has to be replaced.

2.2. The Final Plan

Finally, the project decided to complete the mixing of materials outside the printer. The nozzle structure of the single nozzle printer was changed to enable it to be fed from outside and printed after the material was injected into the nozzle. The improved printer uses liquid silica gel as the raw material.

We removed the single nozzle of the printer, and installed the syringe in the position of the original nozzle in the way of mounting the bracket. The material in the syringe is pressed out through air pressure, and the rate of the material pressed out is precisely controlled, so as to replace the injection effect of the nozzle. The use of high-precision dispensing machine with manual operation can achieve this step.

3. Steps for Improvement

First of all, disassemble the feed part, change the feed port signal line to the syringe pump microcontroller.

Then, remove the double nozzles, only retain the support part, and refit the colloid discharge nozzles.

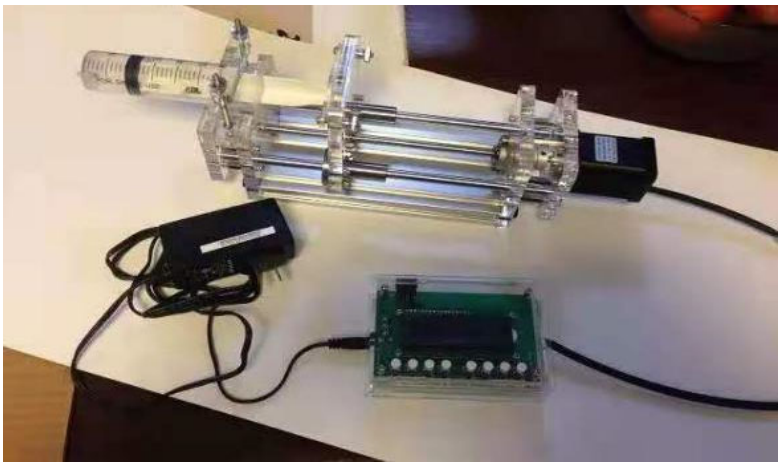

Figure 1. The syringe pump used for feeding

Finally, in terms of programming control, the scheme needs to adjust the running speed and proportion of the two syringe pumps to conform to the material ratio required by the model. Secondly, the original printer nozzle motion control program needs to be rewritten, so that the dual nozzle working together into a single mixed nozzle working alone.

ISSN: 2688-8645

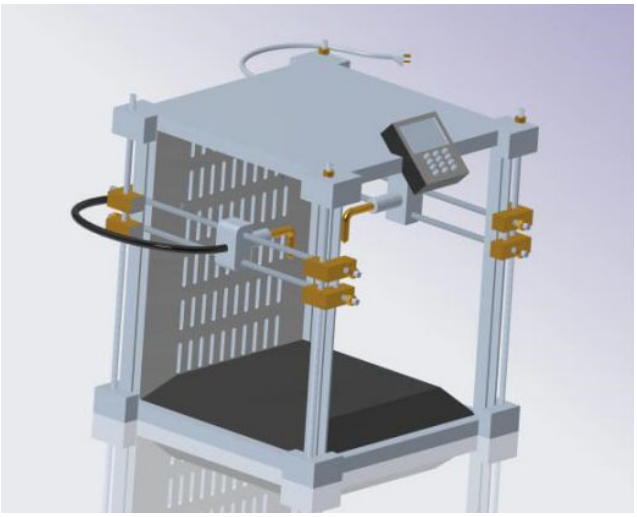

Figure 2. A desired model of the printer's appearance

4. Conclusions

4.1. Advantages of the Improved 3D Printer

1. The workload can be reduced as well as the production difficulty. The improved scheme uses a 3D printer with a single nozzle as the prototype, and the original 3D molding program can be directly used after the nozzle modification, without the need to adapt the program again. This greatly reduces the workload of technical personnel and improves the production efficiency.

2. The material utilization rate can be improved, and the the production process will be more environmentally friendly and save more energy. The modified scheme provides the printing material through a syringe and extrudes the material in the form of gas compression. The hoses used to transfer materials were replaced with gas. This feeding method reduces the cleaning of attachments in the hose, avoids the waste of excess materials in the hose, and improves the utilization rate of materials.

4.2. Disadvantages of the Improved 3D Printer

At present, this project has only completed the preliminary modification of the quantitative mixed multi-material 3D printer. And how to achieve the precise and intelligent control of the syringe discharge through the program still remains to be studied.

References

[1] Jiantao Lv. 3D Printing Technology Principles and Applications. Beijing: People's Posts and Telecommunications Press, 2017.

[2] Guangzhu Xu, Peng He. Open Source 3D Printing Technology Theory and Applications. Beijing: National Defense Industry Press, 2015.

[3] Xiaodong Shen, Yusheng Shi. Inorganic Non-metallic Materials For 3D Printing. Beijing: Chemical Industry Press, 2020.

[4] Jiming Chen, Jiquan Yang. Technology Introduction of 3D Printing. Beijing: Chemical Industry Press, 2020.