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Design of Z axis for CNC milling machine

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***Abstract* — The publication deals with retrofitting of a part of a CNC milling machine. Modification of the machine consists in replacing the Z-axis mechanism. After analyzing the problem, the components were determined. Subsequently, a 3D model of the device was created. In the last part, an animation of the layout of all individual parts of the design was created.**

***Keywords* — CNC milling machine, retrofitting, Z-axis, 3D model**

I. INTRODUCTION

Overhauls of the machine are an essential part of equipment maintenance to ensure the required operation of the equipment. This publication contains documentation of the retrofitting of a CNC milling machine. The restoration of the device consists in replacing the mechanical part of the Z-axis. The main reason for the adjustment is to eliminate errors that occur during machining. The low accuracy and repeatability of the Z-axis position is most evident in finishing machining strategies. The original axis of the CNC machine is formed by a linear guide in the form of rods with linear bearings. For the Z-axis drive, a stepper motor was used in combination with a trapezoidal linear threaded rod and nut. Our task is to design a complete mechanical part of the Z axis. The design of the solution focused on easy assembly. So that the exchange of the Z axis requires only minimal intervention in the CNC milling machine.

The created solution serves to improve and modify the CNC milling machine. Another use of the proposed modifications is the preparation of teaching materials for the subject CAM systems. In which the described work will be used in teaching the use of Fusion 360 software

II. 3D DESIGN

The creation of the 3D design was influenced by the dimensions of the Z-axis base. Other reference parameters were the dimensions of the components used. The new Z-axis consists of a ball and nut SFU1605, which is stored in supports BK12 and BF12. The guide is realized by linear guide rails HGR20 linear square rail and 4 pieces of HGH20CA slides carriage. The reference components are shown in Fig. 1

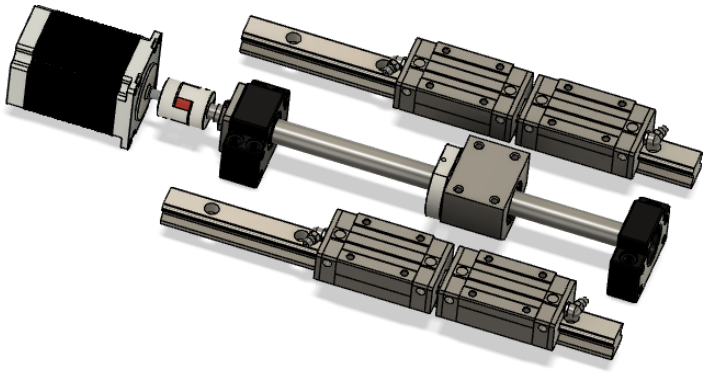

Fig. 1 The Z-axis reference components

All standardized parts were imported from available 3D model sources. The 3D design of the system focused on the greatest possible rigidity of the structure and the simplest on the manufacturability of parts. Figure Fig. 2 shows the complete design. Parts that needed to be designed and manufactured include part A, part B and stepper motor holder. The design of the stepper motor holder was adapted to the production technology using a 3D printer.

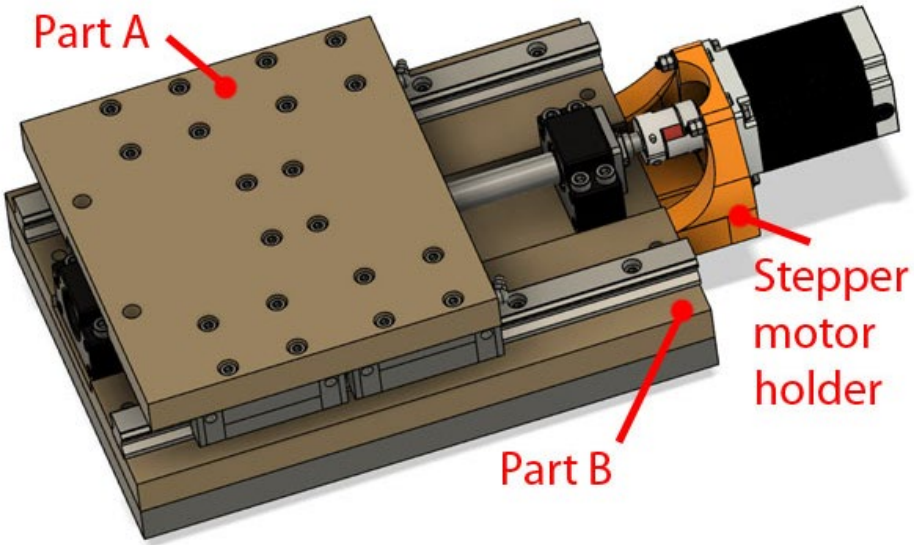

Fig. 2 The complete 3D design of the Z-axis of the CNC milling machine

All structural parts such as screws, securing washers and washers were used in the model for a better overview of the components needed for construction. Such a design allowed us to create an animation of the assembly of all individual parts of the proposed construction. Figure Fig. 3 shows the layout visualization of all components. Allen screws M6x30 and M5x20 are used as connecting material. Visualizations of this type facilitate the assembler's folding process and can also be used as an educational tool for other designers.

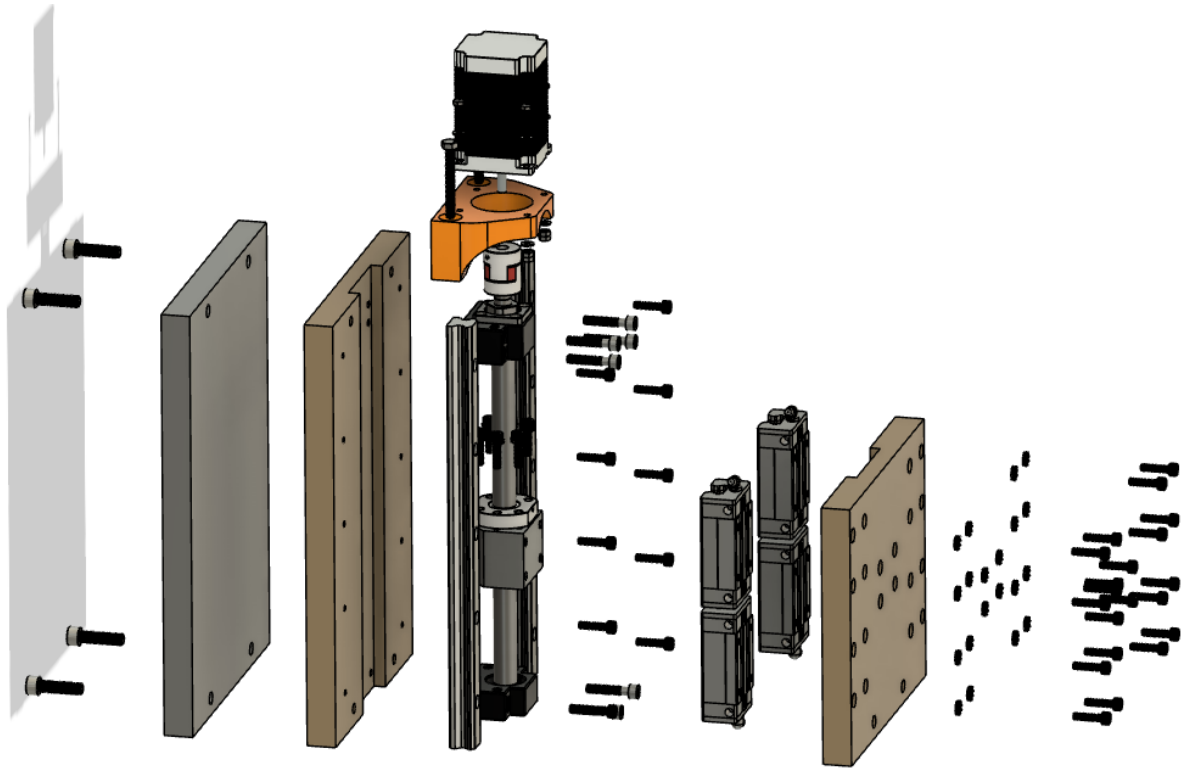

Fig. 3 The layout visualization of the 3D design of the Z-axis of the CNC milling machine

III. CONCLUSION

The main goal of the CNC machine renewal was to improve the machining quality by replacing the Z axis. In the first step, it was necessary to select the individual structural components from the axis of the CNC milling machine to meet the precision requirements of the machine. Other factors were cost minimization while maintaining the longest possible component life. After specifying the individual parts, a design of the mechanical part was created. In the continuation of the work, we will focus on the production of parts using milling and 3D printing.

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