PRODUCTION OF MECANUM WHEELS USING A 3D PRINTER

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Currently, the problem of moving various types of cargo in a limited space is quite important. The manoeuvrability index of this technique is very important for high-quality and fast performance of the task. To improve the manoeuvrability of the equipment, engineers can use both different types of equipment platforms, increase the angle of rotation of the wheels, increase the number of turning wheels, etc.

Variants of solving the problem of movement of various types of cargo in a limited space can be used with the construction of omnidirectional wheels. One type of omnidirectional wheel is the Mecanum wheel, also known as the Elon wheel or as it is sometimes called, the Swedish wheel. Depending on the direction of movement and the speed of each individual wheel, the resulting combination of all forces forms a vector of the total force in the required direction, which allows the platform to move freely in the direction of the resulting force vector, without changing the position of the wheels themselves. Mecanum wheels are widely used in cases where good mobility of the platform is required. The advantages of this type of wheels are compact size and high load capacity.

Fused deposition modelling (FDM) is an additive technology that is widely used in the creation of three-dimensional models, prototyping and industrial production. The FDM technology is simple: a dispensing head applies drops of molten polymer filament to the surface of the platform. The squeezed drops quickly cool and stick together, forming the layers of the future product. The result is a three-dimensional physical model.

To produce a model using the FDM method, namely control of the dispensing head, you need a 3D printer, which is a numerically controlled machine controlled by a microcontroller, which in turn executes movement commands.

The microcontroller of the 3D printer can read commands from the gcode file (or receive them via an interface, for example USB). G-code is a conventional name for the programming language of numerically controlled devices (NPC), it is a sequence of commands for forming a model of a future product.

The main materials for 3D printing are various types of plastics, thermoplastics. Usually have the appearance of a long rod, threads, typical sizes are 1.75, up to 3 mm. The main types of plastics are presented in Table 1.

*Tabl*e 1. Types of plastics for FDM Printing

Material	Characteristic	Using
ABS (Acrylonitrile Butadiene Styrene)	Strong and durable. Heat-resistant and shock-resistant	Functional prototypes
PLA (polylactic acid)	Strong, tough, but fragile Less resistant to the effects of temperature and chemicals	Conceptual models Realistic prototypes
PETG (polyethylene terephthalate glycol)	Compatible with low print temperatures for faster production Resistant to moisture and chemicals	Functional prototypes, waterproof models
Nylon	Hard, durable and light Strong and partially flexible Heat-resistant and shock-resistant	Functional prototypes Wear-resistant models
Composite materials (carbon fibre, Kevlar, optical fibre)	Strong, tough and incredibly hard	Functional prototypes Clamping and fastening devices, tool equipment

We can use different materials to print the Mecanum wheel (Figure 1), depending on its size. ABS and PETG, or composite materials, are suitable as a base for the rim of the wheel, and nylon is suitable for the manufacture of rollers (Rollers) of the wheel. The model in Cura (an open source 3D model slicer for 3D printers) will look like Figure 2.
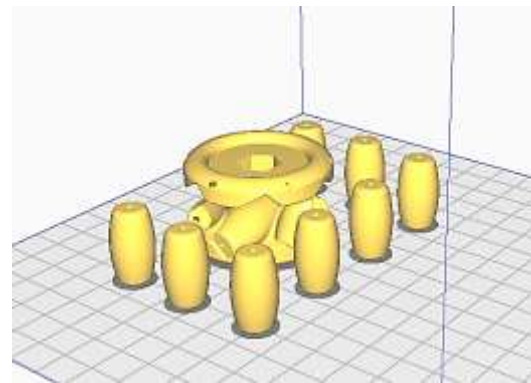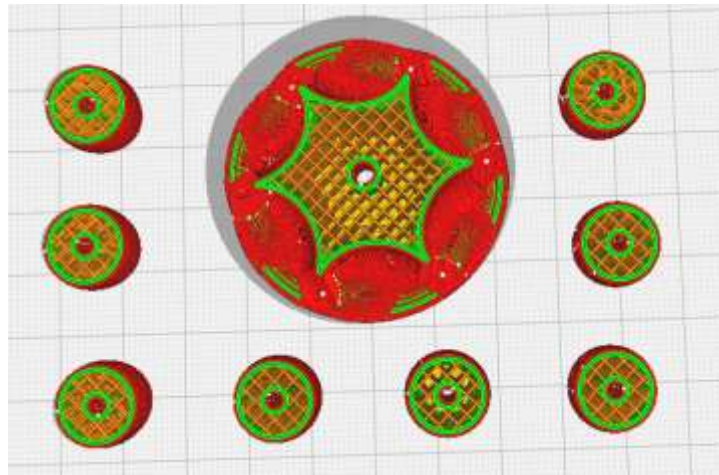

Fig. 1. 3D model of the Mecanum wheel

Fig. 2. 3D model of the Mecanum wheel in Cura

After cutting the model into layers, it will look like Figure 3. The program cuts the model into many layers, and creates G-code to control the 3D Printer. Therefore, in the slicer program, we can view the model and make certain corrections for the printing features of the right 3D Printer.

Fig. 3. 3D model of the Mecanum wheel layers

The FDM printing technology is very attractive for the automotive industry as well, building both prototypes and working models. Depending on the size and needs, you can change the filling of the model inside, as well as the strength of the walls, the height of the layer, etc. Thus, we can control the characteristics of our wheel by changing these parameters. By changing the type of plastic, we change the properties of the structure.

References:
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WAYS OF MITIGATION DATA BREACHES FOR GLOBAL ENTERPRISE COMPANIES

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Data breaches are a serious threat to enterprise companies as they can result in loss of sensitive information, reputational damage, and financial losses [2], which explicates the topicality of our work.