CAD/CAM technologies in vocational studies

Deni Makovec, student
Ivan Veljović, mag.ing.mech
Sven Maričić, Associate Professor

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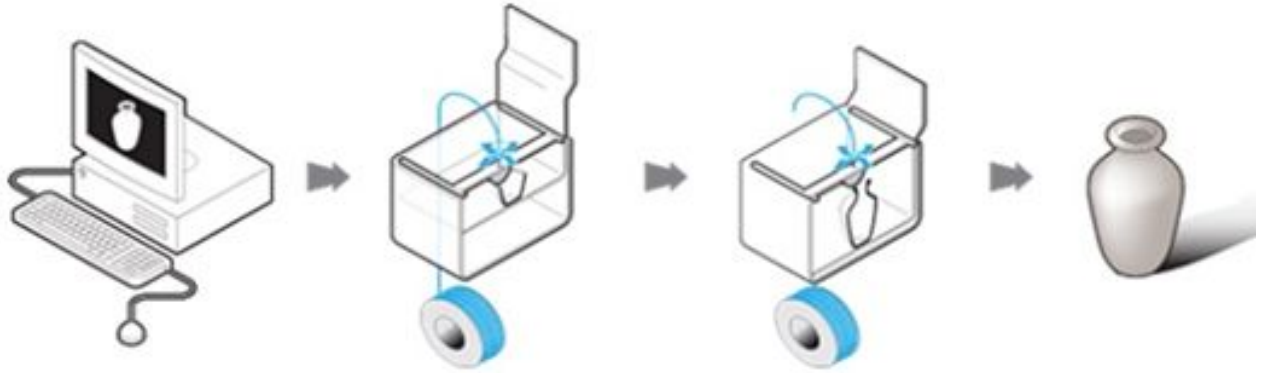
Keywords:

- VET
- CAD/CAM
- Additive technologies
- FFF



Picture: FFF technology overview
https://i.materialise.com/blog/en/3d-printing-technologies-and-materials/ (accessed: 2020-08)]

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vocational studies, dual curricula

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- Vocational studies emphasize the industrial work experience of the students during their studies.
- In vocational curricula, CAD /CAM technologies play an important role, especially in:
  - mechanical design,
  - practical manufacturing simulation,
  - digital production.

Case study, 3D printer part optimisation

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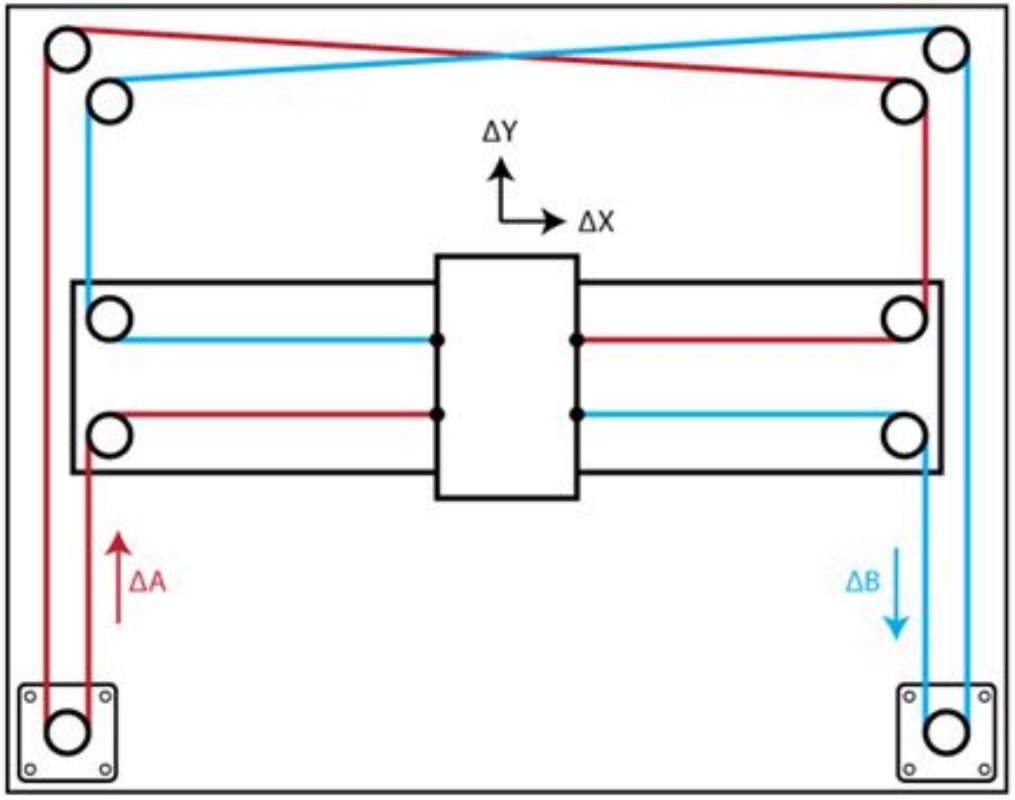

Picture: Schematic presentation of FFF printer

In the context of having better hands-on experience, low-budget 3D printers have also been developed, which have become very affordable and allow a significant expansion of the use of additive manufacturing for development and production. One of them was designed as part of a master's thesis. The printer shown in the figure is a CoreXY 3D printer, FFF printer with a Cartesian coordinate system in a slightly different design. One of the biggest advantages of CoreXY printers is that they can print faster without leaving behind artifacts in your print. This is because there are no moving parts of the significant mass.

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$$(1) \qquad \Delta X = \frac{1}{2}\,(\Delta A + \Delta B) \qquad ; \qquad \Delta Y = \frac{1}{2}\,(\Delta A - \Delta B)$$

$$(2) \qquad \Delta A = \Delta X + \Delta Y \qquad ; \qquad \Delta B = \Delta X - \Delta Y$$

Expression 1&2: Movement equations

With other printer designs, there's typically a moving gantry that is attached to the stepper motors or the print bed. During a print, this gets hurled back and forth, which tends to cause excess vibration and results in artifacts. On the other hand, the CoreXY design has all of the stepper motors fixed, and the print bed moves vertically. This means that the tool head is the only part of the printer that is being moved at an appreciable speed with significant mass, and therefore a lot less vibration occurs.

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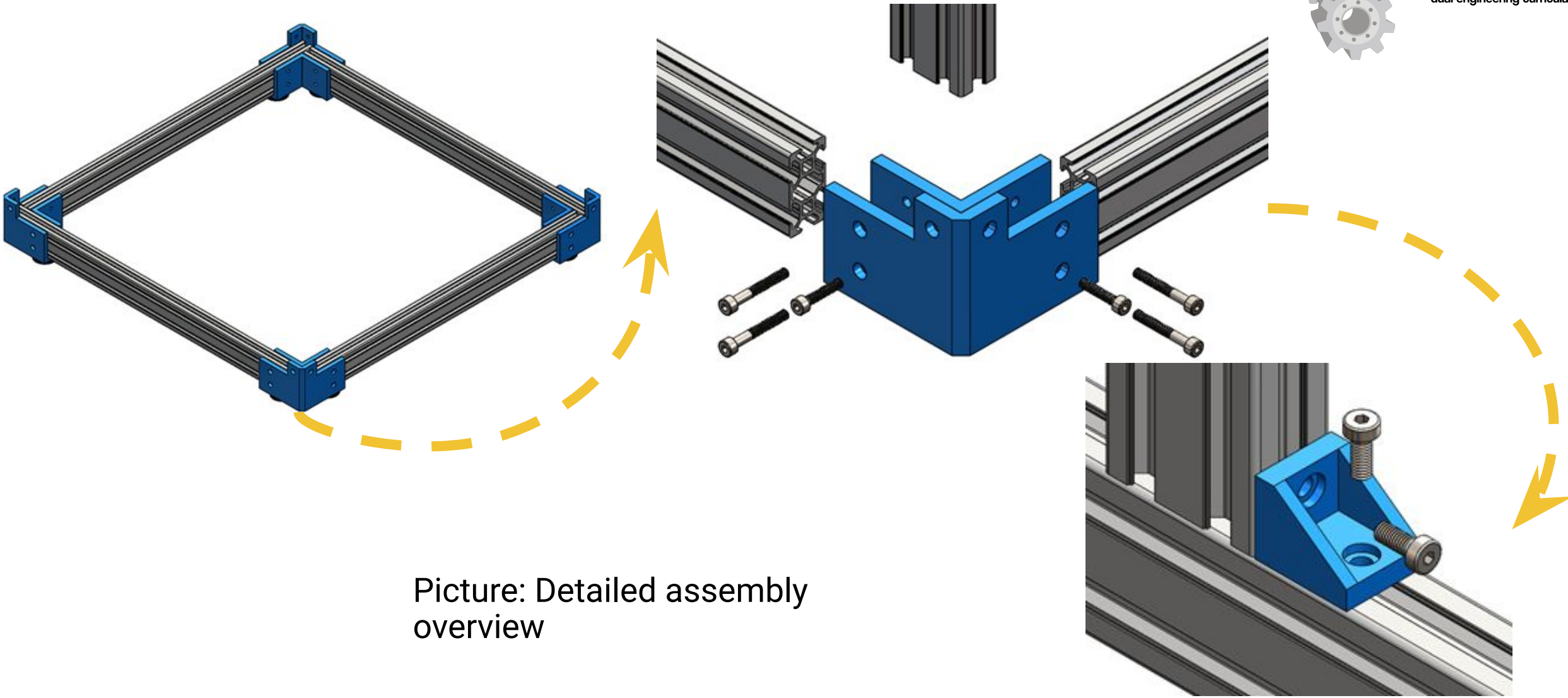

Picture: Detailed assembly overview

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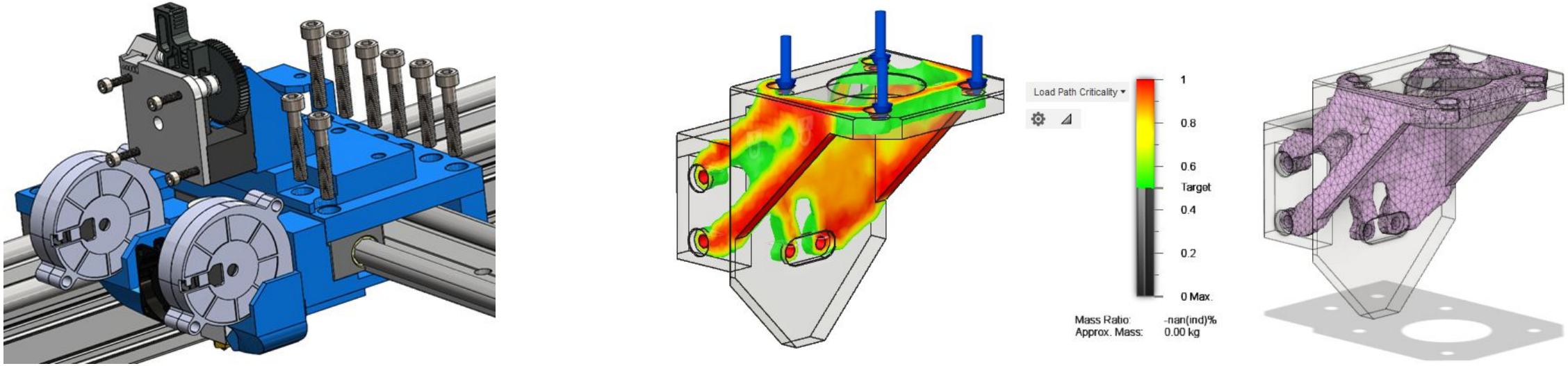
- In our case all the printed parts will be made of PLA material while the restrictions will be placed on the holes where the parts are bolted to the aluminum profiles. The loads that are present in these cases are minimal, ie the force of gravity and the mutual tension of the individual components.
- The payload check was performed on all parts intended for 3D printing, while the following pictures show only some of them.



Picture: Display of load distribution and 3D mesh representation of X and Y motor support

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- It is very important to follow the direction of development of new technologies in the CAD /CAM environment.
- This approach combines theoretical teaching with new manufacturing technologies.

MATERIJAL	PLA	ABS	PETG	NAJLON
Temperatura za 3D ispis (°C)	170-220	240-280	210-235	220-270
Temperatura grijane radne podloge (°C)	50-60	90-110	50-80	70-90
Brzina ispisa (mm/s)	40-100	40-70	30-80	40-80
Cijena ($/kg)	15-40	25-50	20-60	25-65
Karakteristike	100% biorazgradiv, jednostavan za 3D ispis, odličan omjer cijene i kvalitete	Otporan na udarce, podnosi visoku temperaturu, dizajniran za profesionalnu upotrebu	Temperaturno stabilan do 80 °C, iznimno izdržljiv, otporan na UV zračenje, odličan omjer cijene i kvalitete	Fleksibilan, otporan na visoke temperature

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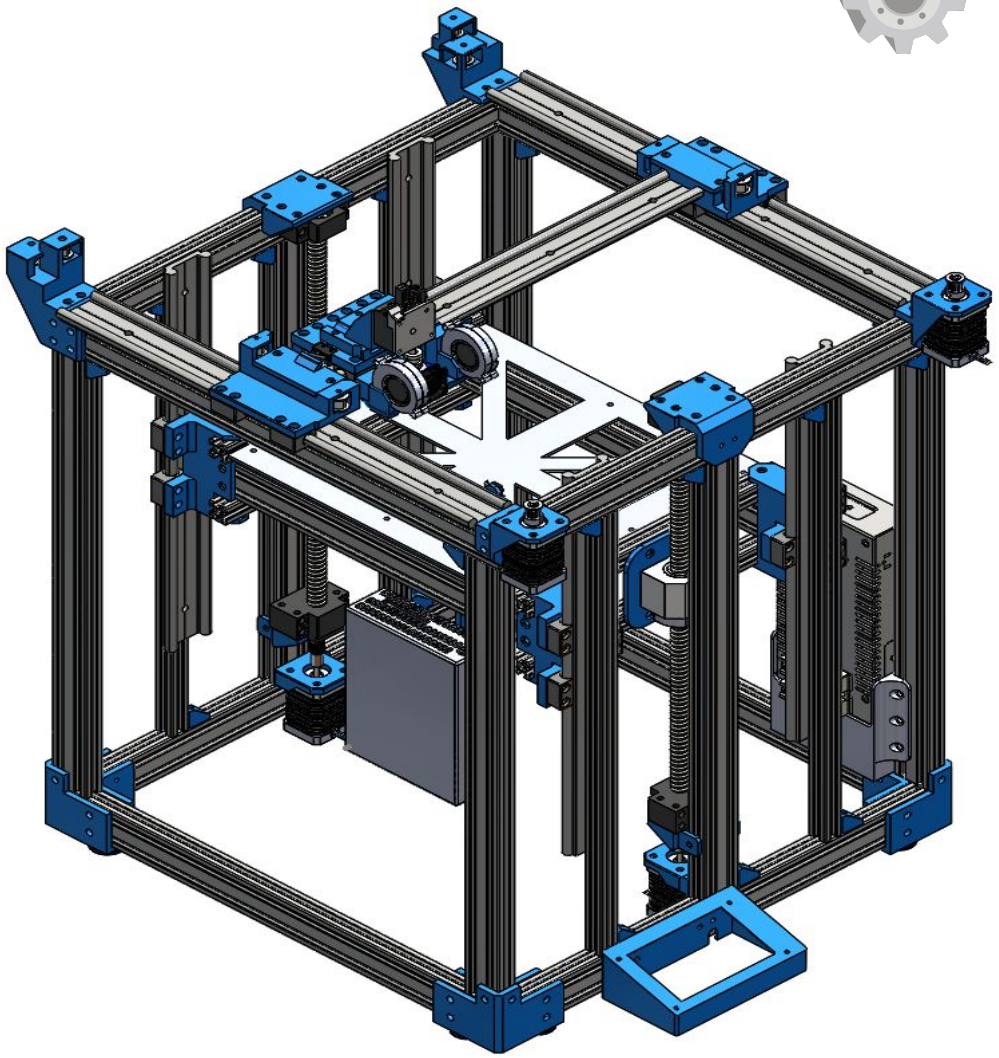

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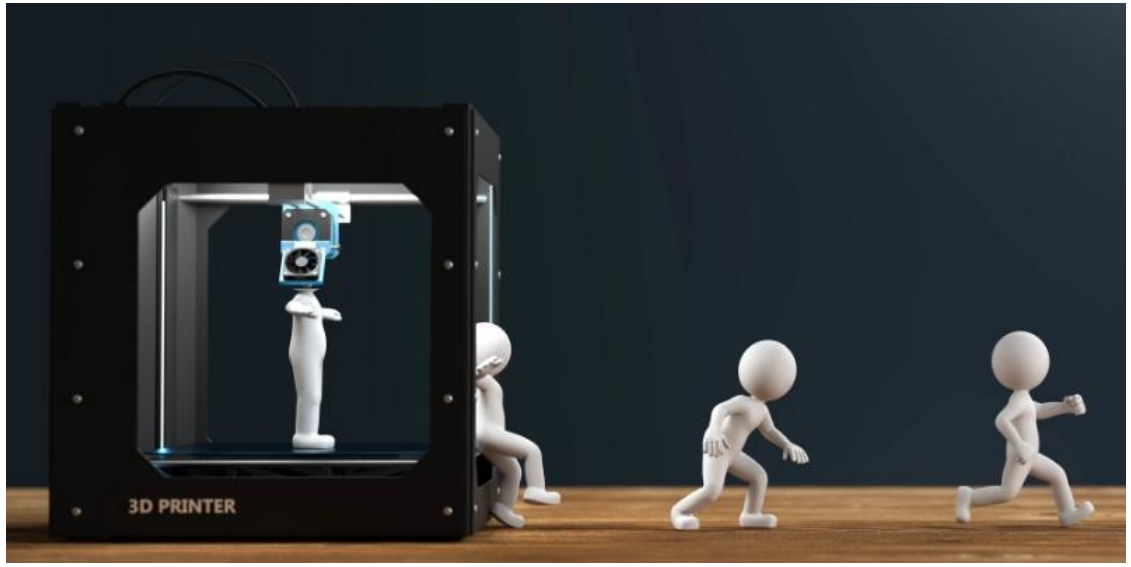
THANK YOU FOR YOUR ATTENTION!



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