Powder Removal Device for Metal Additive Manufacturing

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Introduction

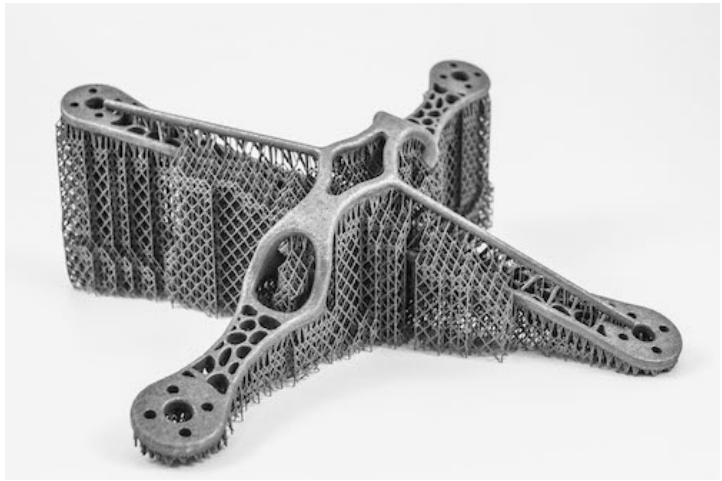
Major part of metal additive manufacturing is done with powder bed-based methods

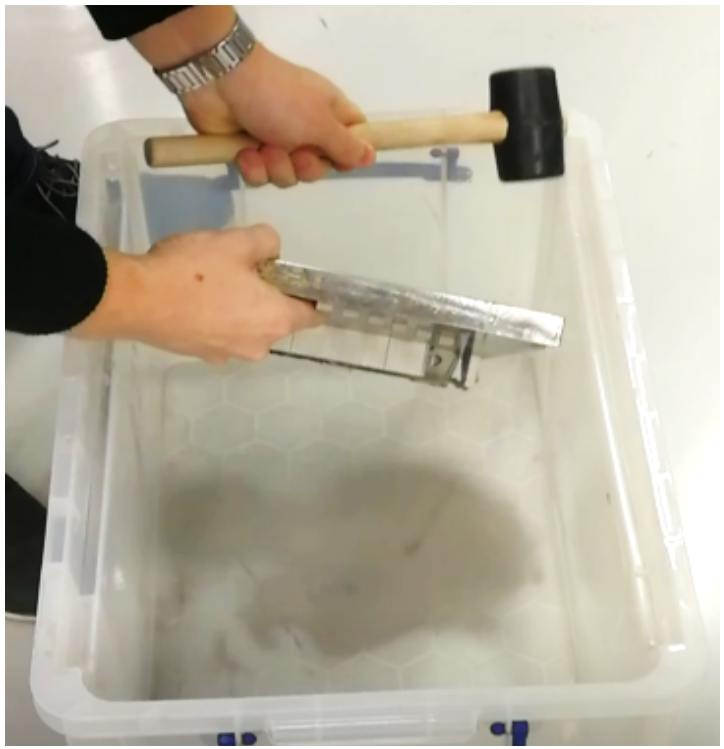
Metal powder trapped inside the workpiece needs to be removed from support structures before detaching it from building platform and before postprocessing

Inhaled powder causes respiratory issues and skin contact is also harmful

Powder removal is intensive and time-consuming labor if it is done manually with basic tools

There is a clear need for more efficient method for removal





Requirements for design

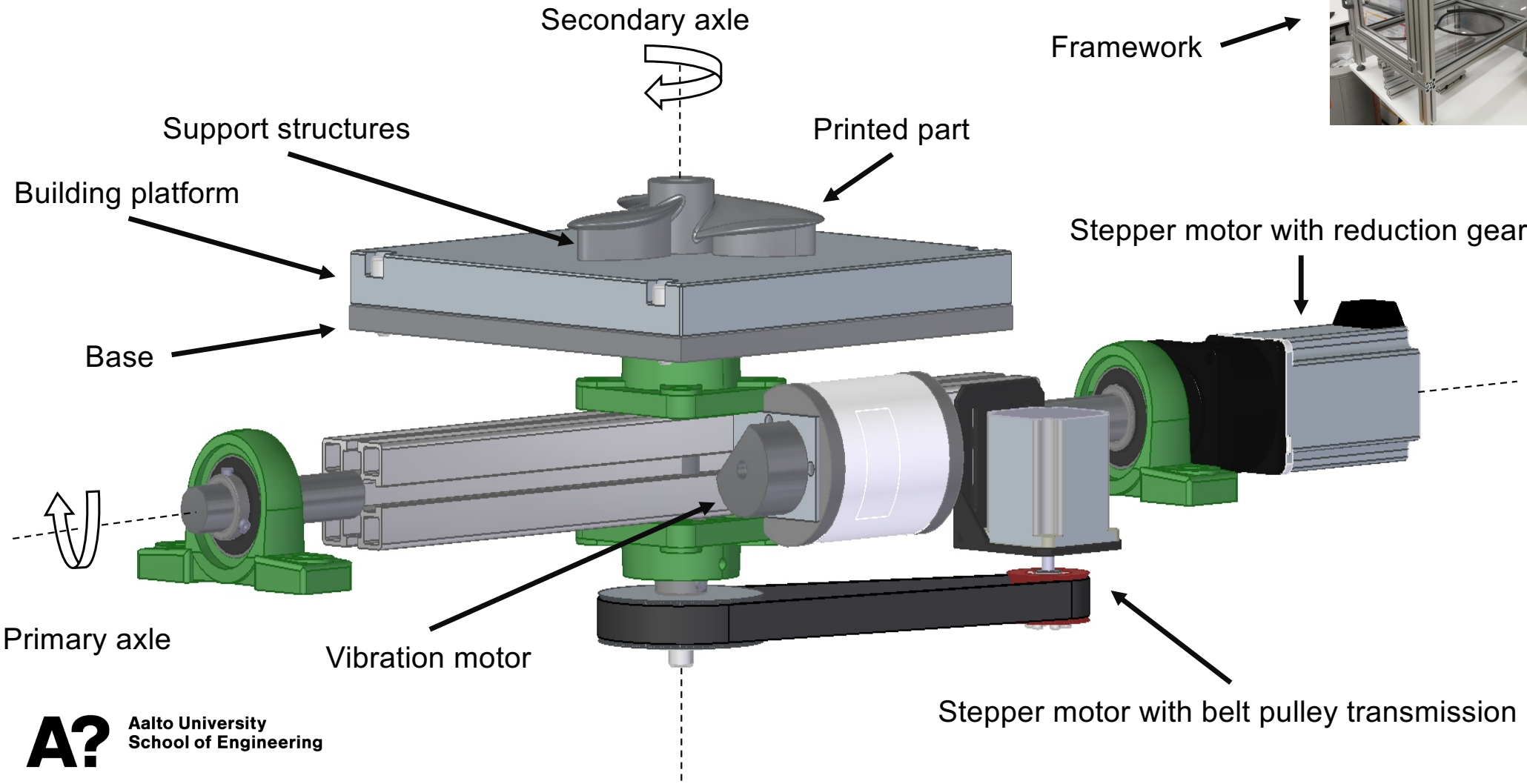
With automatic powder removal device, the removal process can be performed safely and efficiently.

Main requirements:

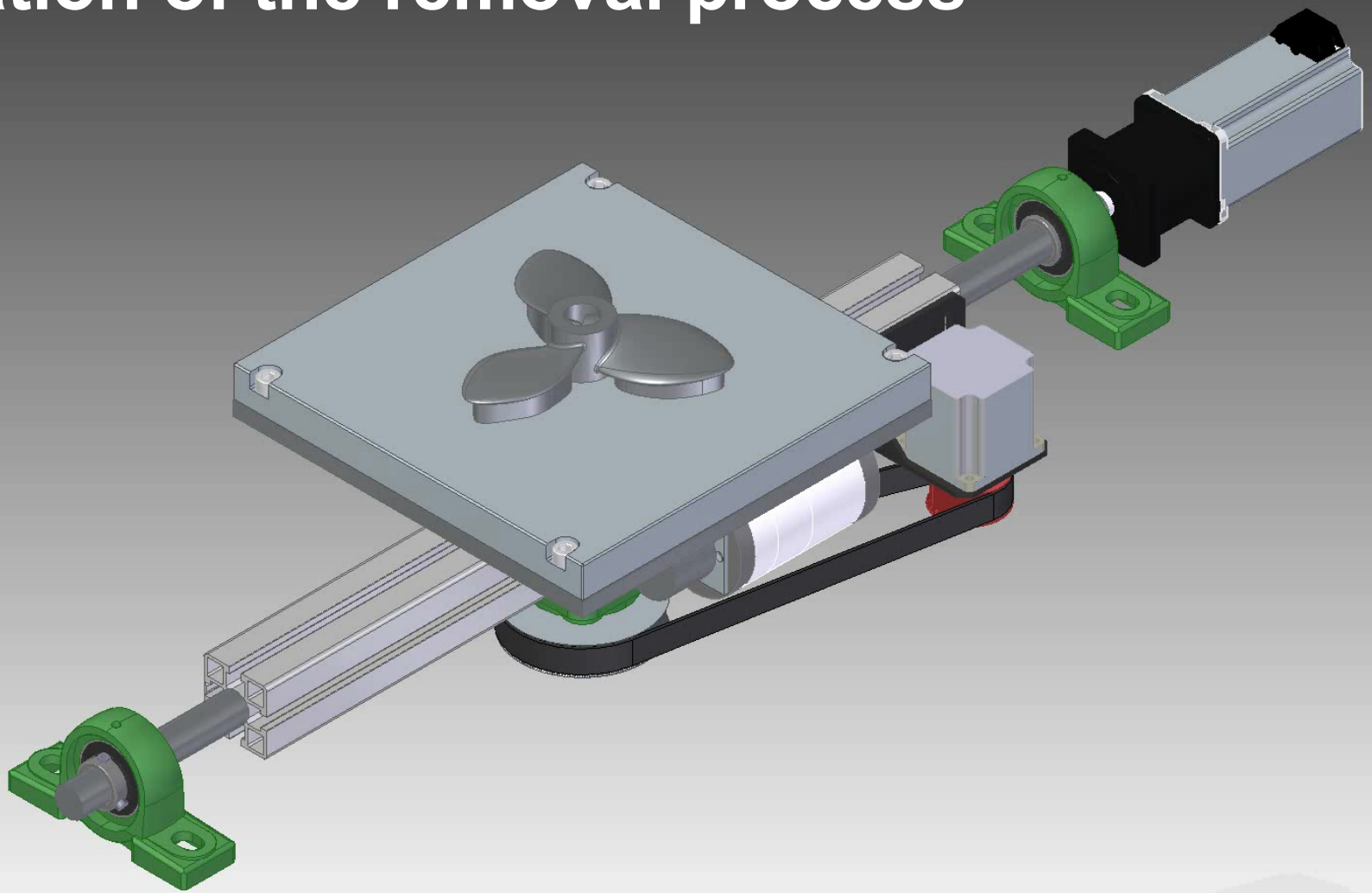
- **Full removal of trapped powder by vibration or impact shocks**
- **Simple to use interface and automatic process**
- **Full orientation changes for the workpiece**
- **Closed chamber with door and sealings for airtight enclosure**
- **Easy installation of the workpiece**
- **Rigid structure, compact design and low cost**
- **Chamber dimensions for printed part including build platform: 250 x 250 x 325 mm**

Concept - mechanism

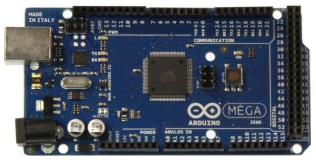
Framework



Animation of the removal process



Concept - components



Power supply

300 W
12 V

Microcontroller

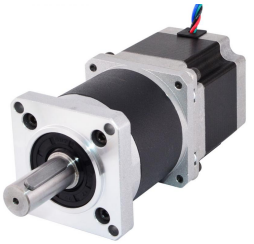
Arduino Mega

54 digital I/O pins

Primary axis rotation

Nema 23 stepper motor

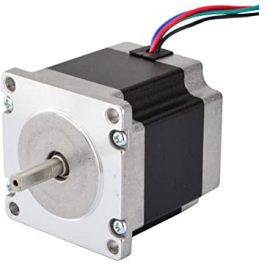
3.6 V, 2 A
1.2 Nm (~58 Nm with reduction gear) , 1.8° step angle
Polulu A4988 motor driver



Secondary axis rotation

Nema 23 stepper motor

3.6 V, 2 A
0.9 Nm, 1.8° step angle
Polulu A4988 motor driver



Vibration for removing powder

DC motor with eccentric weight

120 W, 24 V, 5 A
Relay control

User interface

LCD display, controls for stop, start and choosing duration of removal process

Operation procedure

1. Operator detaches part including building platform from 3D printer
2. Operator installs the building platform to the base on the removal device
3. Operator closes the airtight door, sets up the time on control panel and starts the removal process
4. Device turns the workpiece around by two axes and vibrates it at the same time in order to remove the trapped powder

Discussion

- In conclusion, an automatic powder removal device was designed, it is cost-efficient and simple to use
- Variety of building platforms can be installed to the base with minor modifications, and the aluminum profile body dimensions are also easy to change for compatibility

- Vibration for dislodging the powder is executed with an eccentric weight mounted to the DC motor
- To further improve the removal performance, a striker can be added for impact shocks to remove the powder

- A scale for measuring the amount of removed powder could be also added to the system to quantify the powder removal
- This would give more certainty to the user by providing information about powder removal amounts in specified time