# Plastic Recycling System

Documentation_30.10.24

**Jeeda Sabbagh | Aya Al Atrash | Abdullah Kojak**

# Contents

# The Impact of plastic Consumption in our lives

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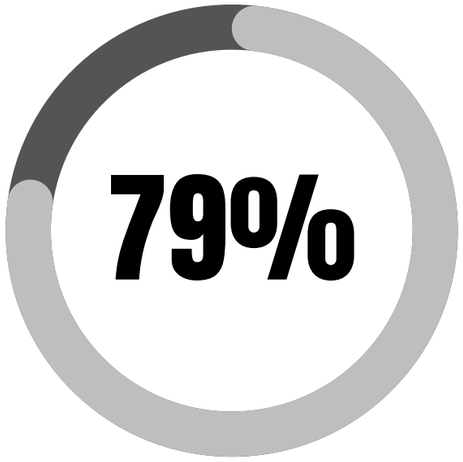
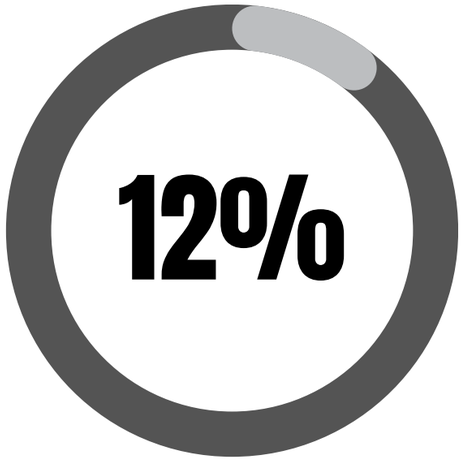
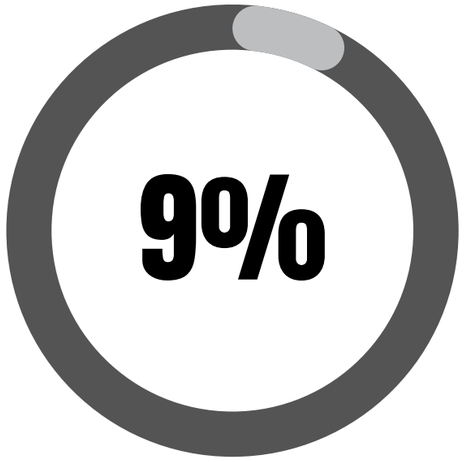



Wasted plastics ends up in landfills or the environment




Burnt plastic




Recycled plastic

Around 8 million metric tons of plastic enter the oceans every year.

Between 75 and 199 million tons of plastic are currently in our oceans.

Geyer, R., Jambeck, J.R. & Law, K.L., 2017. Production, use, and fate of all plastics ever made. Science Advances, 3(7), p.e1700782. Available at: https://doi.org/10.1126/sciadv.1700782 [Accessed 20 Nov. 2024].

# Exploring Different Types of Recycled Plastic Materials

# Materials

PET HDPE PVC LDPE PP PS Other

# PLASTIC FEATURES TO RECYCLE

| Property | PET | HDPE | LDPE | PVC | PP | PS | Other Plastics |
|---|---|---|---|---|---|---|---|
| **Clarity** | Clear | Translucent | Translucent | Clear | Translucent | Clear | |
| **Moisture barrier** | Fair to good | Good to excellent | Good | Fair | Good to excellent | Poor to fair | |
| **Oxygen barrier** | Good | Poor | Poor | Good | Poor | Fair | |
| **Maximum temperature** | 120°F | 145°F | 120°F | 140°F | 165°F | 150°F | |
| **Rigidity** | Moderate to high | Moderate | Low | Moderate to high | Moderate to high | Moderate to high | - |
| **Impact resistance** | Good to excellent | Good to excellent | Excellent | Fair to good | Poor to good | Poor to good | |
| **Heat resistance** | Poor to fair | Good | Fair | Poor to fair | Good | Fair | |
| **Cold resistance** | Good | Excellent | Excellent | Fair | Poor to fair | Poor | |
| **Sunlight resistance** | Good | Fair | Fair | Poor to good | Fair | Poor to fair | |
| **Common uses** | Soft drink bottles, food containers, clothing fabrics | Plastic rulers, hula hoop rings, toiletry packaging containers, roadside curbs, benches, tables, cargo truck liners | Flexible container lids, squeezable bottles, and frozen food bags | Packaging containers, electricity installation cables, rigid pipes, credit cards, synthetic leather | Reusable microwave containers, kitchen utensils, disposable food containers, soft drink bottles | Disposable cups, trays, packing containers, egg cartons | Polycarbonate, polylactide, etc., are used in baby milk bottles, riot shields, plastic toys, sunglasses lenses, automotive headlamps |
| **Recycling information** | It can be mechanically recycled wherein PET bottles are cleaned, shredded, and melted to form a new plastic resin. Chemical recycling is also explored from which high-quality recycled PET resin can be extracted. | Due to its rigidity, it is difficult to shred and melt. HDPE products are collected, separated, cleaned to remove contaminants, shredded, melted, and then molded into new products, such as bottles, crates, and | The process is mostly similar to HDPE but its high flexibility makes it difficult to sort as it gets tangled up with substances. LDPE items are also more prone to contamination. | After collection, sorting, and cleaning, it is shredded into small pieces (flakes and granules). After that chlorine is removed chemically, then cleaned again to reprocess into new PVC materials. | After collection, sorting, cleaning and shredding, the shredded PP is melted at a high temperature and then extruded through a machine to create uniform plastic resin. | After collection, sorting, cleaning, and shredding, EPS foam especially is compacted or densified to reduce its volume. For this, the foam is melted & compressed into denser blocks. It is then extruded through a | Based on several factors such as rigidity or flexibility, it may be difficult or easy to recycle several plastics. |

Plastic Recycling: Process, Methods, Challenges Innovations and Regulations

# UAE Plastic Recycling Centers

## UAE PLASTIC RECYCLING CENTERS

In the United Arab Emirates (UAE), several facilities specialize in shredding and recycling PET (polyethylene terephthalate) plastics. Notable centers include:

1.Planet Green Recycling
Dubai, UAE
Offers comprehensive plastic waste recycling services, including shredding and processing of PET plastics into secondary raw materials.

2. Planet Green Bee'ah Recycling Facility
Sharjah, UAE
Operates advanced recycling facilities that handle various types of plastic waste, including PET, through processes like shredding and reprocessing.
BEEAH Group | UAE –

3. Tadweer (Abu Dhabi Waste Management Center)
Abu Dhabi, UAE
Manages waste collection and recycling services, including the shredding and recycling of PET plastics, as part of Abu Dhabi's sustainability initiatives.
These centers play a crucial role in the UAE's efforts to promote sustainability and reduce plastic waste by processing PET plastics into reusable materials.

THE UAE ENERGY STRATEGY **2050** FOCUSES ON BALANCING ECONOMIC GROWTH WITH CLEAN ENERGY, TARGETING A **50% CLEAN ENERGY** MIX AND A **70%** REDUCTION IN CARBON EMISSIONS.

## UNDERSTANDING THE PLASTIC RECYCLING PROCESS

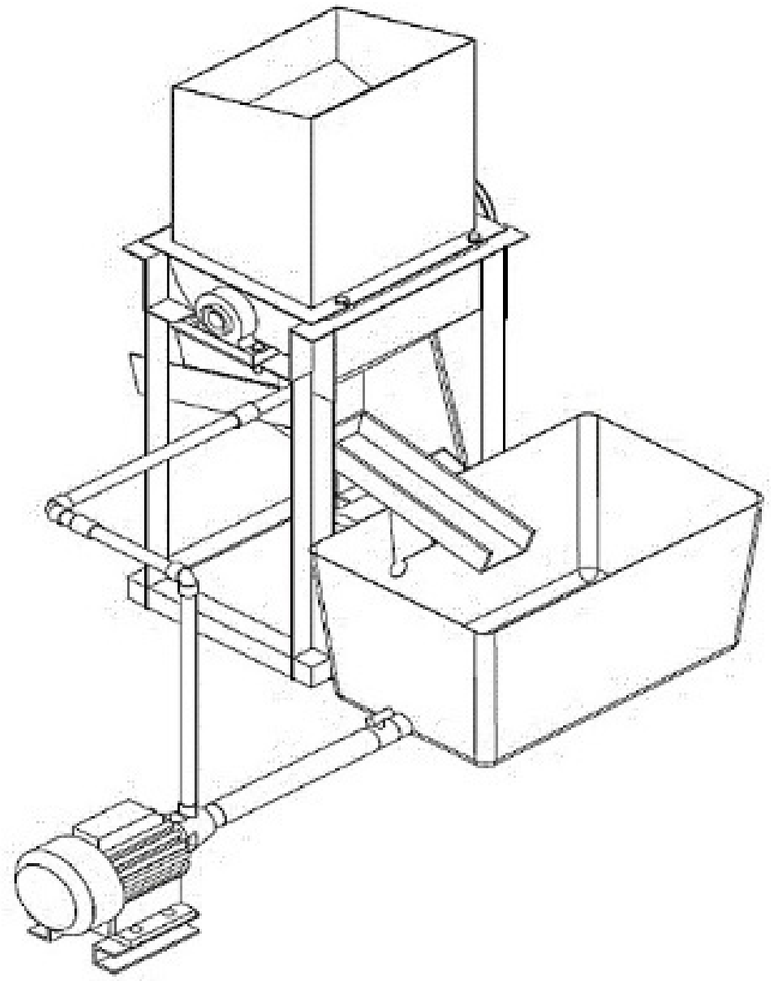
- Washing and Contaminant Removal:
  Shredded PET flakes are thoroughly washed to remove contaminants like labels, glue, and other impurities that may affect the quality of the recycled material.

- Sorting and Separation: The clean plastic flakes are sorted by color and quality, as certain applications require uniform or specific colors. Some facilities use automated systems like infrared or optical sorting for greater efficiency.

- Melting and Extrusion: Once sorted, the PET flakes are melted and extruded into pellets or granules, known as recycled PET (rPET). These pellets can be used as a raw material for various products, ranging from textiles to packaging materials.

# Exploring Different Types of Shredder Machines to build our recycling system

# DEVELOPMENT OF SHREDDING AND WASHING MACHINE FOR POLYETHYLENE TEREPHTHALATE (PET) BOTTLES PELLETIZER



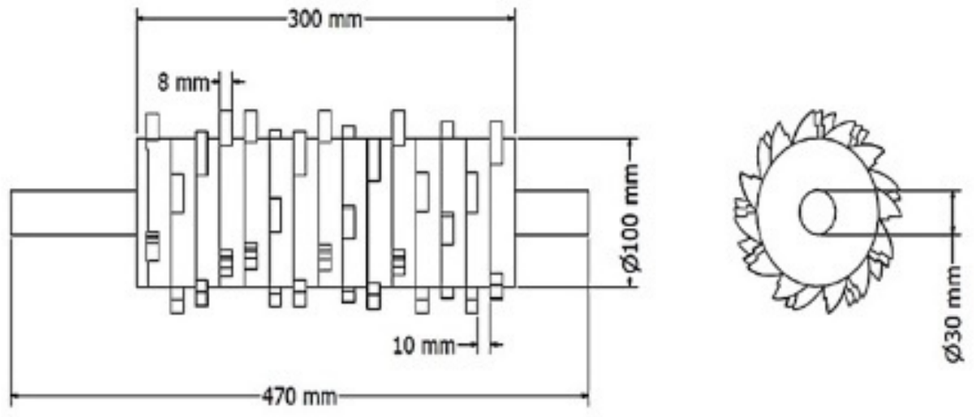



Figure 2:

**Figure 2**: Cutter

1. Deripark. (n.d.). Article file from Dergipark. [online] Available at: https://dergipark.org.tr/en/download/article-file/747529 [Accessed 20 Nov. 2024].

## MACHINE COMPONENTS

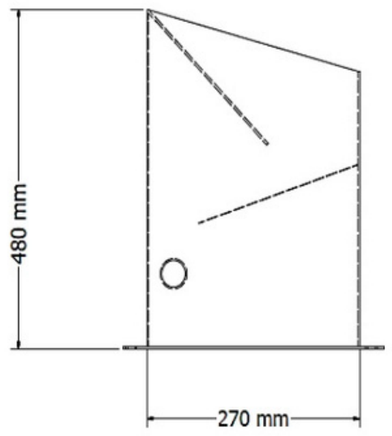



Figure 1: Hopper

**Hopper:**

**Capacity**: Can accommodate approximately 15 PET bottles at a time (based on standard Coca-Cola bottle dimensions).

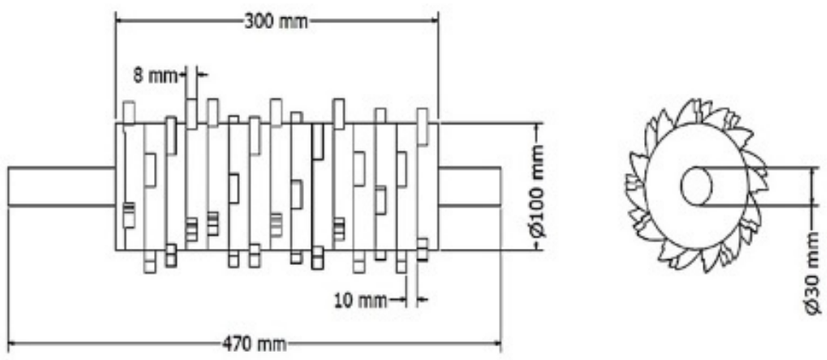


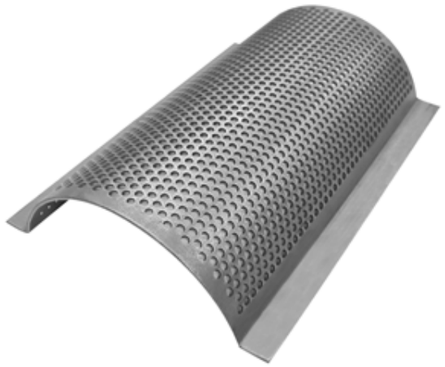

Figure 2:

**Figure 2**: Cutter

- **Blades:**
- **Shredding Speed:** Variable speed operation, ranging from 187.5 rpm to 350.2 rpm.
- **Shredding Efficiency:** Maximum shredding efficiency of 60.01% at 1.8 kg/hr and 350.2 rpm, which produces particles smaller than or equal to 10mm².

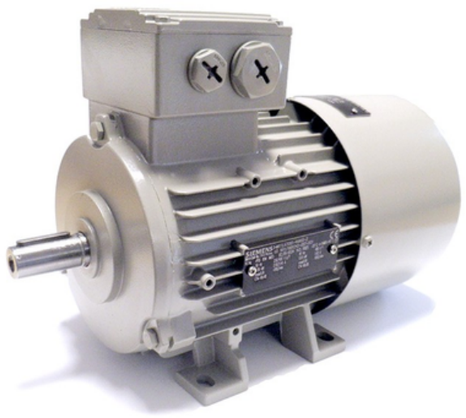
Deripark. (n.d.). Article file from Dergipark. [online] Available at: https://dergipark.org.tr/en/download/article-file/747529 [Accessed 20 Nov. 2024].

## MACHINE COMPONENTS



**Screens:**

- **Adjustable Screens:** Positioned after the shredding process to sieve particles. Only particles of the desired size (10mm²)



**Electric Motor:**

- **Power**: 5 HP single-phase electric motor powers the shredding mechanism.
- **Speed Control:** Allows for variation in shredding speed based on material input, with speeds ranging between 187.5 rpm and 350.2 rpm.

**Frame and Support Structure:**

- **Materia**l: Designed to be sturdy and portable, allowing for easy movement of the machine while ensuring durability during operations.

Deripark. (n.d.). Article file from Dergipark. [online] Available at: https://dergipark.org.tr/en/download/article-file/747529 [Accessed 20 Nov. 2024].

## PERFORMANCE DETAILS

**Input Capacity:**

- The machine is capable of processing 50-75 kg of PET bottles per hour depending on the speed and feeding rate.
- Optimal feeding rate is 1.8 kg/hr for maximum efficiency.

**Shredding Efficiency:**

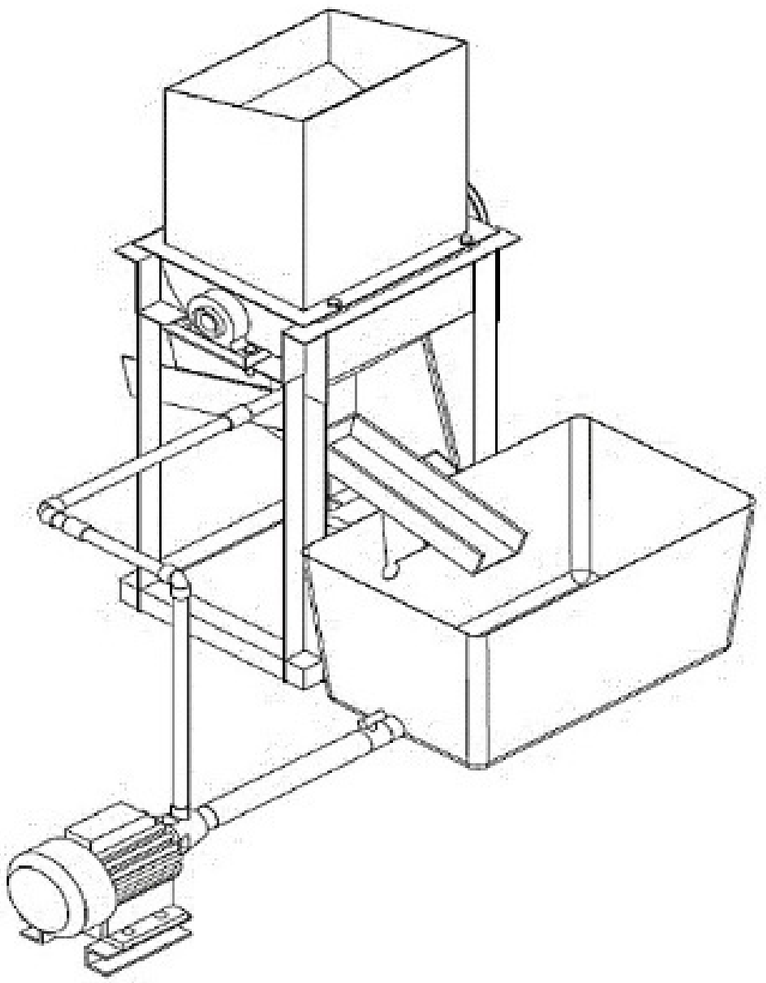
- At a feeding rate of 1.8 kg/hr and a machine speed of 350.2 rpm, the machine achieves a shredding efficiency of 60.01%.
- This efficiency measures the percentage of shredded plastic with a size equal to or smaller than 10mm² relative to the total shredded material.

**Recycling Efficiency:**

- The recycling efficiency of the machine reaches 93.73% at a feeding rate of 1.8 kg/hr and a machine speed of 273.8 rpm. This measures the amount of usable material after shredding.

**Time for Shredding:**

- The average shredding cycle for an input of 1.2 kg of plastic is approximately 5 minutes. This may vary depending on the feeding rate and motor speed settings.



Deripark. (n.d.). Article file from Dergipark. [online] Available at: https://dergipark.org.tr/en/download/article-file/747529 [Accessed 20 Nov. 2024].

*Table 1: Bills of materials*

| S/N | Component part list | Quantity |
|---|---|---|
| 10 | Shredder Hopper | 1 |
| 9 | Motor Cover | 1 |
| 8 | 1hp Electric Motor | 2 |
| 7 | Die breaker plate | 1 |
| 6 | Die plate | 1 |
| 5 | Shredder shaft | 2 |
| 4 | Auger screw shaft | 1 |
| 3 | Extruder hopper | 1 |
| 2 | Belt drive | 2 |
| 1 | Frame | 1 |

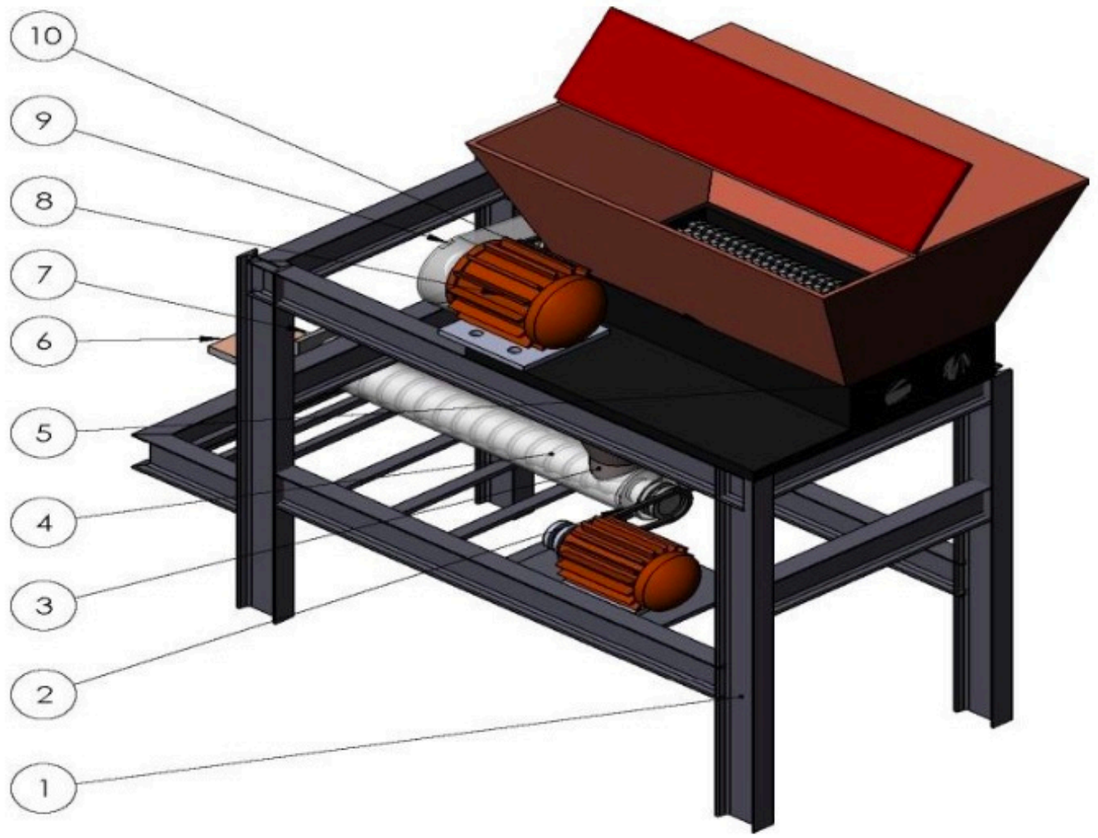


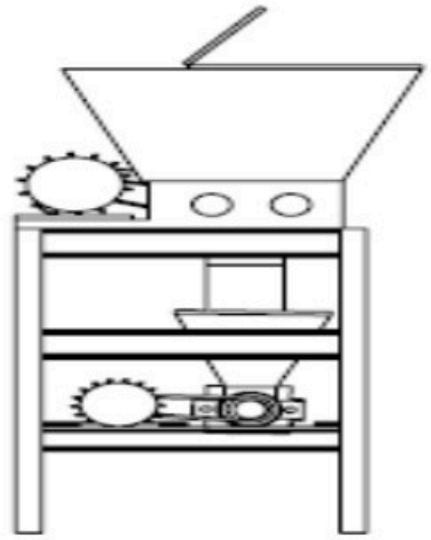

*Figure 1: The assembly view of the recycling machine*

AJOL. (2017). Plastic extruder system design study. [online] Available at: https://www.ajol.info/index.php/njt/article/view/155084 [Accessed 20 Nov. 2024].

## MACHINE COMPONENTS

**Shredder Hopper**

- It can hold approximately 55.12 kg of PET plastic, which occupies about 75% of the hopper's volume.

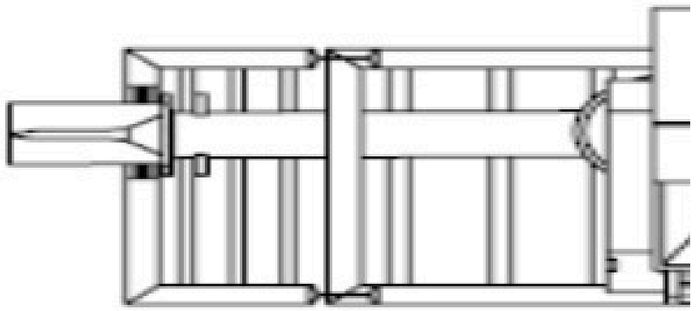


**Shredder Shafts:**

- The machine uses two shredder shafts with knife-edge ring cutters. One shaft is driven by a 1-hp electric motor through a belt-pulley system, while the other shaft remains stationary.

**Extruder Hopper:**

- After shredding, the plastic flakes are fed into the extrusion hopper. This hopper has a volume of approximately 7,487,269 $mm^3$ and can hold about 9.82 kg of shredded plastic.



AJOL. (2017). Plastic extruder system design study. [online] Available at: https://www.ajol.info/index.php/njt/article/view/155084 [Accessed 20 Nov. 2024].

## MACHINE COMPONENTS

**Extrusion Chamber:**

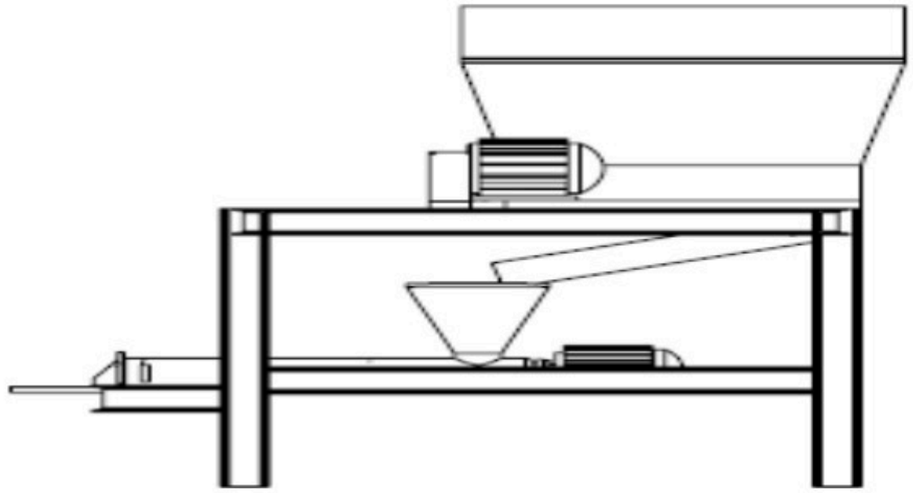
- The shredded plastic is heated in the extrusion chamber to a molten state at temperatures between 250°C and 265°C.
- The chamber is equipped with an electric heater jacket and a thermostat to maintain the molten state of the plastic before extrusion.

**Auger Screw Shaft:**

- Inside the extrusion chamber, the auger screw shaft rotates to move the molten plastic toward the extrusion orifice. The auger is driven by a ¼ hp electric motor.

**Frame:**

- The frame of the machine is constructed from malleable steel, designed to support the loads generated during operation. It can handle loads of up to 1204 N on the top level and 271 N on the bottom level, with a high factor of safety (FoS) of 8.3.



AJOL. (2017). Plastic extruder system design study. [online] Available at: https://www.ajol.info/index.php/njt/article/view/155084 [Accessed 20 Nov. 2024].

## MACHINE PERFORMANCE

- **Plastic Capacity:** The shredder hopper can handle 55.12 kg of PET plastic, and the extrusion hopper holds about 9.82 kg at a time.
- **Processing Time**: The extrusion process has a design capacity of approximately 493 kg per hour.
- **Efficiency:** The machine design suggests high operational efficiency, with factors of safety for the key components (frame and shafts) well above the required minimum.
- **Power Requirements: T**wo electric motors are used — a 1-hp motor for the shredding section and a ¼-hp motor for the extrusion process.

AJOL. (2017). Plastic extruder system design study. [online] Available at: https://www.ajol.info/index.php/njt/article/view/155084 [Accessed 20 Nov. 2024].

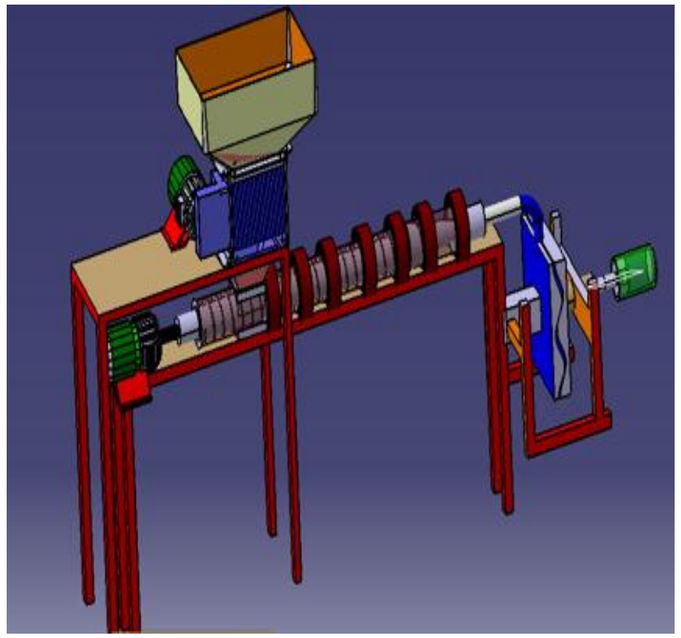


**Figure.26. Assembly drawing of the machine.**

**Figure 4. Model of Plastic Recycling Machine**

1. IJITEE. (2019). Innovative plastic extruder mechanisms. [online] Available at: https://www.ijitee.org/wp-content/uploads/papers/v9i3/B7432129219.pdf [Accessed 20 Nov. 2024].

## MACHINE COMPONENTS

### Shredder Hopper

- Volume: 53,257,488 mm³ (about 55.12 kg of PET plastic).

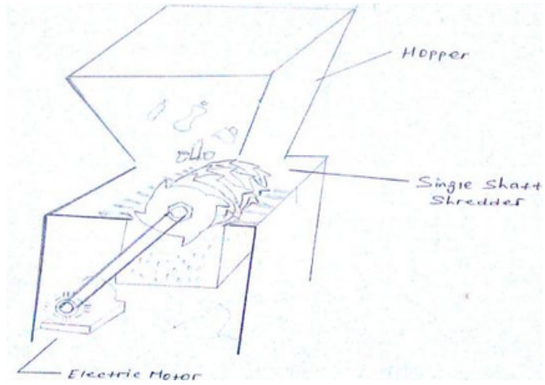



**Figure 7. Single shaft shredder**

### Shredder Shafts:

- Two shafts are used with knife-edge ring cutters for shredding plastic into smaller flakes.
- One shaft is driven by a 1-hp electric motor.
- The shredded plastic is then transferred to the extrusion chamber.

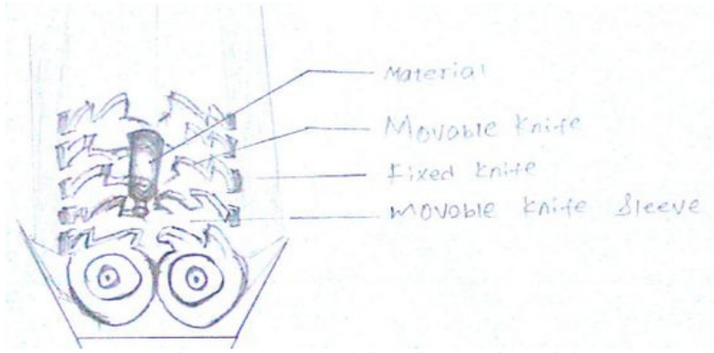



**Figure 8. Double shaft shredder**

### Extruder Hopper:

- Holds shredded plastic before it is fed into the extrusion chamber.
- Volume: 7,487,269 mm³ (approximately 9.82 kg of shredded plastic).

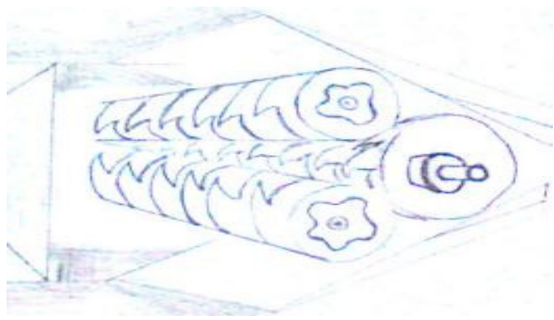


**Figure 9. Triple shaft**

1. IJITEE. (2019). Innovative plastic extruder mechanisms. [online] Available at: https://www.ijitee.org/wp-content/uploads/papers/v9i3/B7432129219.pdf [Accessed 20 Nov. 2024].

## MACHINE COMPONENTS

**Extrusion Chamber:**

- The chamber heats the shredded plastic to a molten state using electric heater jackets.
- Temperature: 250°C – 265°C.
- The molten plastic is forced through a die to create a filament, which is cooled in a water bath.

**Auger Screw Shaft:**

- The auger screw pushes the molten plastic toward the extrusion orifice.
- Driven by a ¼ hp electric motor.
- Design capacity: 0.137 kg/s (493 kg/hour of finished product

**Cooling System:**

- The extruded plastic filament passes through a water bath for cooling and solidification.

**Belt Drive System:**

- Transmits power between the shredder and extrusion units.
- Utilizes a rubber belt.

**Electric Motors:**

- 1-hp motor for shredding.
- ¼ hp motor for extrusion

1. IJITEE. (2019). Innovative plastic extruder mechanisms. [online] Available at: https://www.ijitee.org/wp-content/uploads/papers/v9i3/B7432129219.pdf [Accessed 20 Nov. 2024].

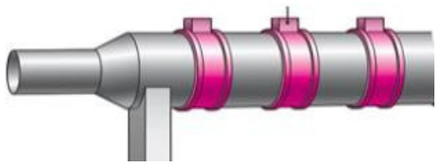


Figure22(a). barrel heater

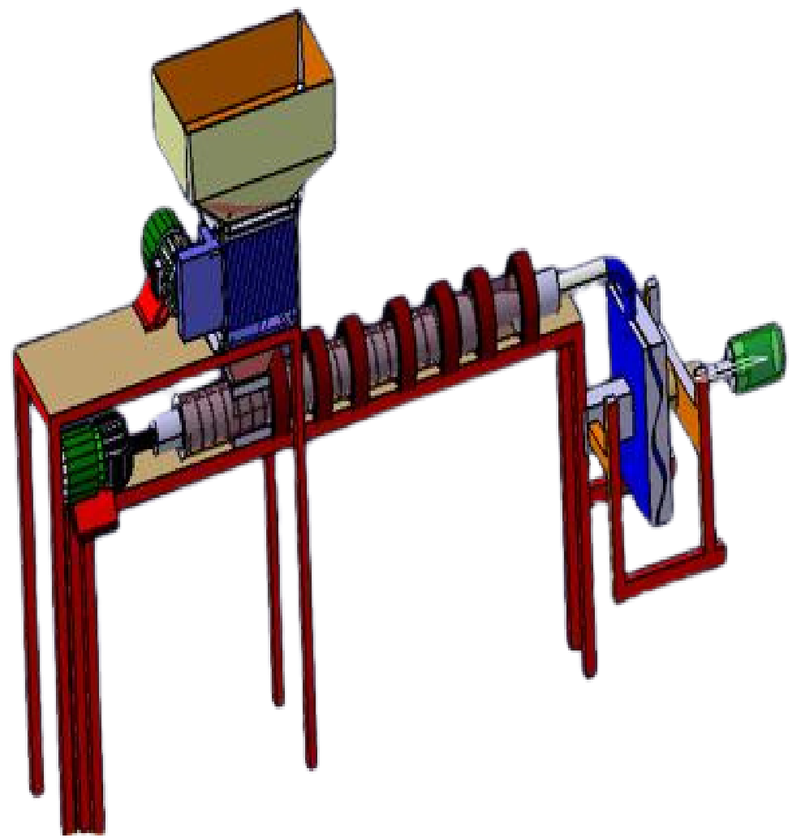


**Figure.26. Assembly drawing of the machine.**

## MACHINE PERFORMANCE

**Processing Time:**

- The machine completes three full cycles per minute, resulting in a production rate of 180 products per hour.

**Capacity:**

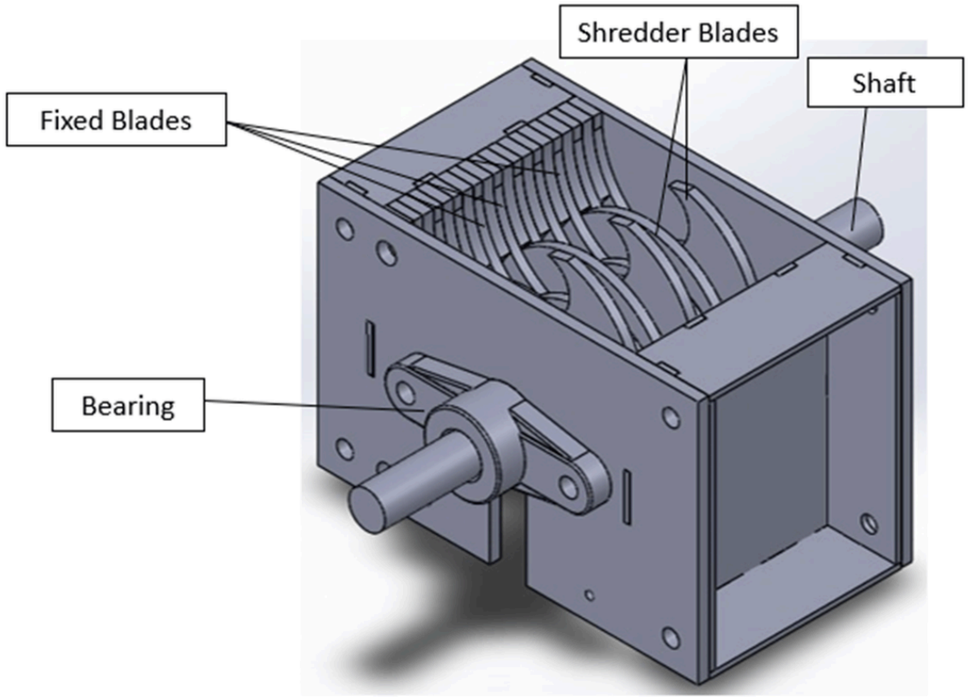
- The machine can process up to 20.4 kg of plastic per hour, producing thin filament or blocks.
- Input weight: 12.8 kg, Output weight: 10.2 kg.

**Efficiency:**

- The machine operates at an efficiency rate of 80%, meaning 80% of the input plastic is converted into the final product.

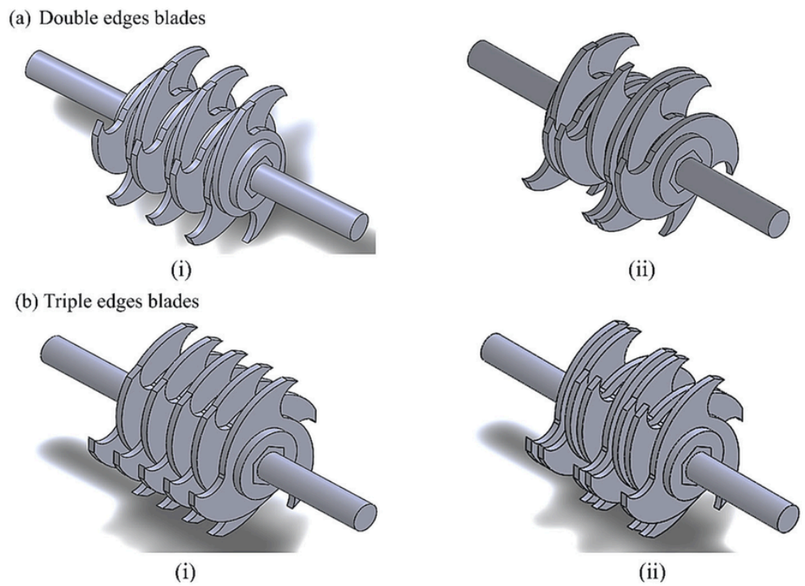
1. IJITEE. (2019). Innovative plastic extruder mechanisms. [online] Available at: https://www.ijitee.org/wp-content/uploads/papers/v9i3/B7432129219.pdf [Accessed 20 Nov. 2024].

# WEAR MECHANISMS AND PERFORMANCE OF PET SHREDDER BLADE WITH VARIOUS GEOMETRIES AND ORIENTATIONS



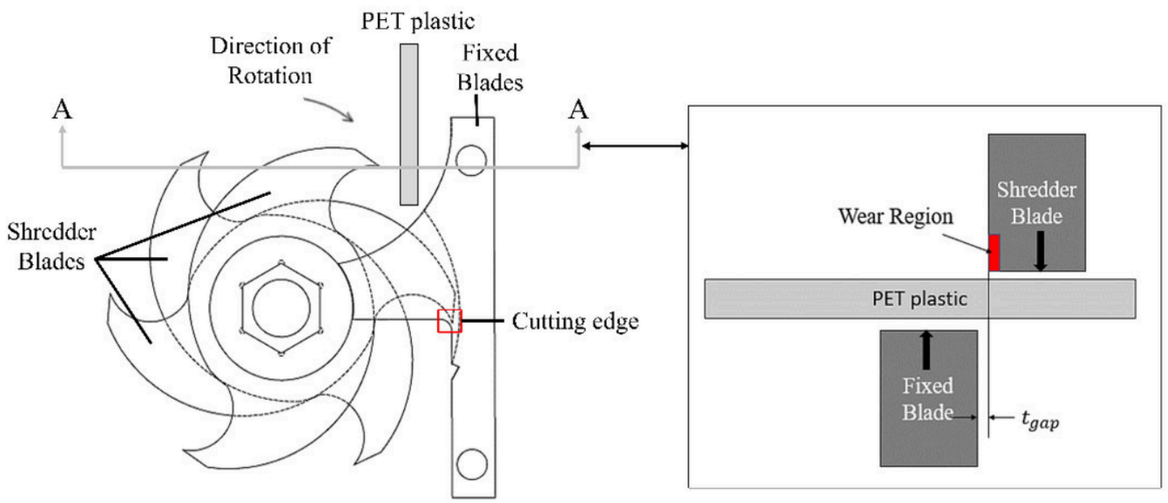

**Motor and Gearbox:**
The shredder uses a 3 hp single-phase electric motor that operates at 2800 rpm. To increase torque and improve shredding performance, the motor is connected to a 1:60 ratio gearbox, which reduces the rotation speed to about 47 rpm.

**Blades:**
The shredder is equipped with double-edge and triple-edge blades made from low-carbon steel. These blades are known for their toughness and durability, making them suitable for processing PET plastic.
The cutting blades are mounted on a hexagonal shaft and arranged in different orientations, including spiral and V-orientation to optimize the shredding process.

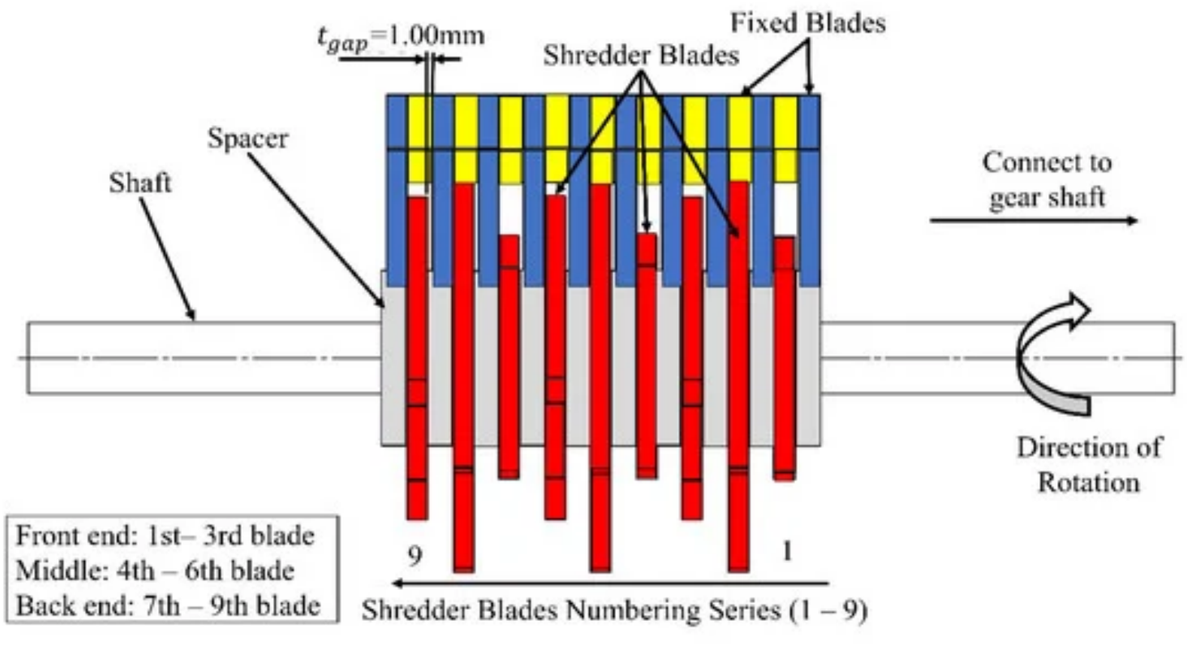



Wong, J.H., Karen, W.M.J., Bahrin, S.A., Chua, B.L., Melvin, G.J.H. and Siambun, N.J., 2022. Wear Mechanisms and Performance of PET Shredder Blade with Various Geometries and Orientations. Machines, 10(9), p.760.

# PERFORMANCE DETAILS




(a) (b)




**Shredding Mechanism:**

The machine operates by feeding **PET** plastic between two sets of blades arranged along parallel axles. The shredding happens at the intersection of these blades, which apply a shear force to cut the plastic.

The gap between the rotating and fixed blades is set at 1.00 mm, allowing for efficient cutting while ensuring the plastic doesn't get stuck during the shredding process.

Wong, J.H., Karen, W.M.J., Bahrin, S.A., Chua, B.L., Melvin, G.J.H. and Siambun, N.J., 2022. Wear Mechanisms and Performance of PET Shredder Blade with Various Geometries and Orientations. Machines, 10(9), p.760.

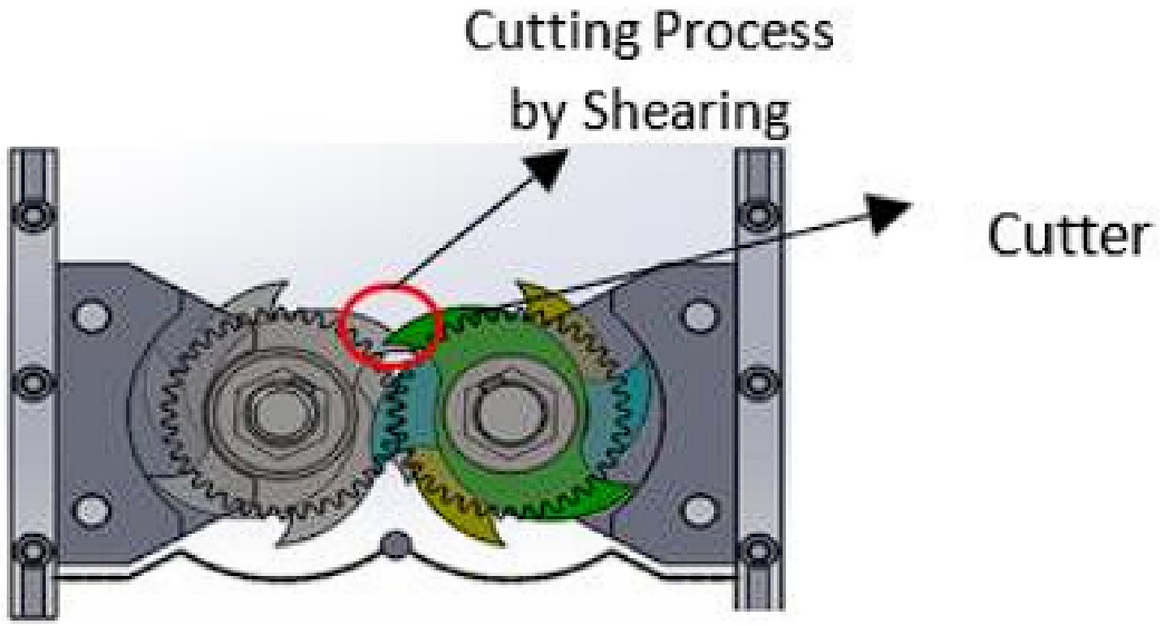



**Figure 10.** Shear Force.

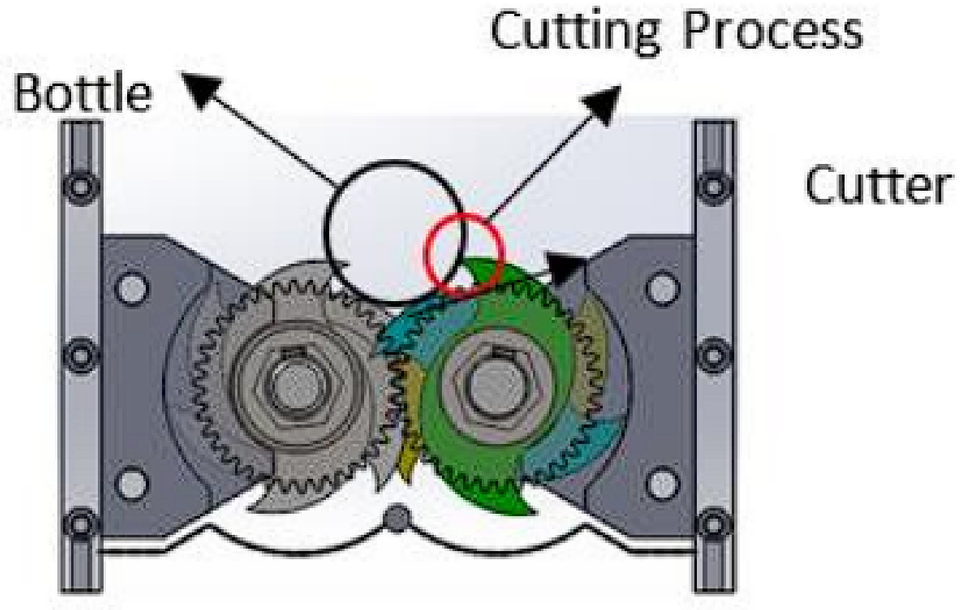
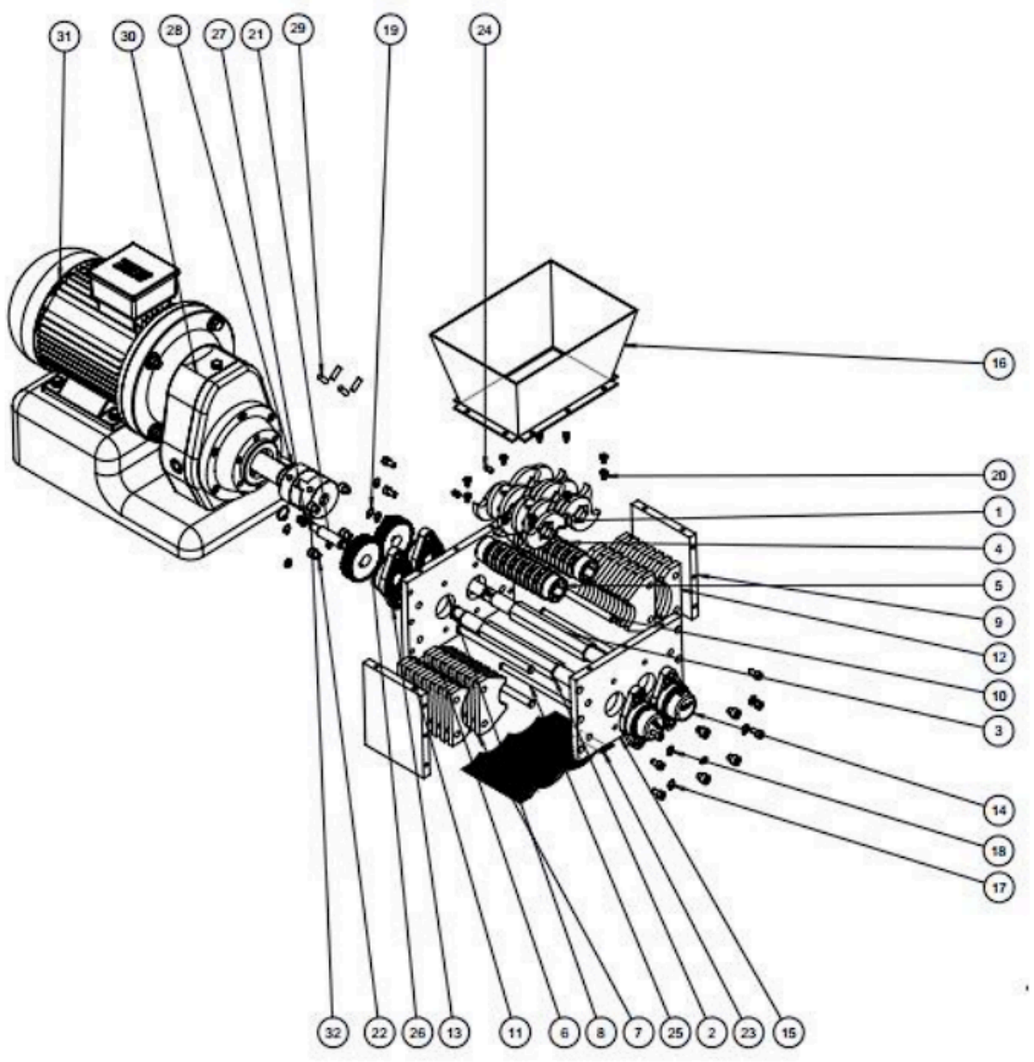



**Figure 9.** Tension Force.

- **Shear force** is responsible for cutting the material, while **tensile force** stretches or pulls the material into position for the cutting to take place.
- They work together in this cutting machine, with the tension force preparing the material and the shear force completing the cutting action.

Wong, J.H., Karen, W.M.J., Bahrin, S.A., Chua, B.L., Melvin, G.J.H. and Siambun, N.J., 2022. Wear Mechanisms and Performance of PET Shredder Blade with Various Geometries and Orientations. Machines, 10(9), p.760.

## SHREDDER COMPONENTS

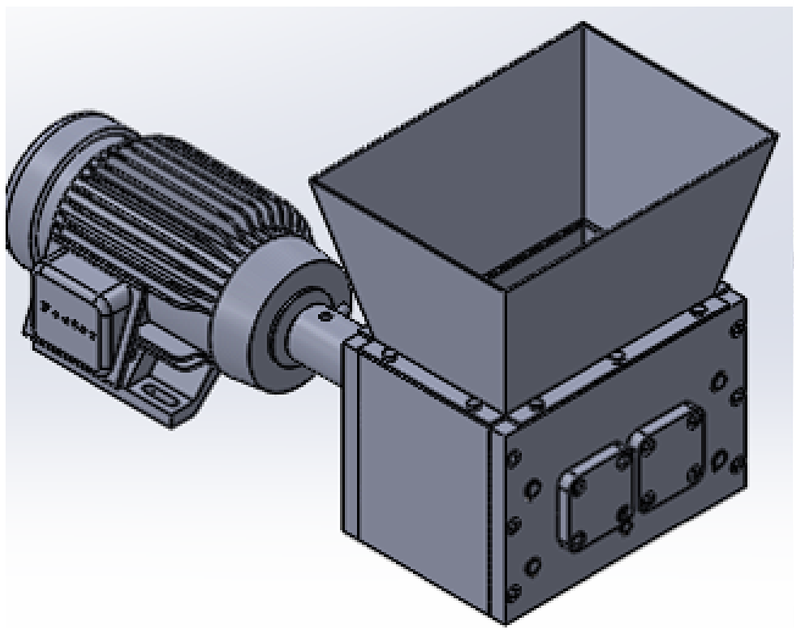



Where:

| | | | |
|---|---|---|---|
| 1 | Cutter | 17 | Circlip Side Poros |
| 2 | Hexagonal Shaft | 18 | Circlip Poros Mesh |
| 3 | Hexagonal Shaft Motor | 19 | Circlip Roda Gigi |
| 4 | Spacer | 20 | Bolt Hexagonal M6 |
| 5 | Bush | 21 | Holder Idler |
| 6 | Side Cutter | 22 | Baut Inbus M8 |
| 7 | Side Cutter Step | 23 | Mesh |
| 8 | Front Plate | 24 | Spi Roda Gigi |
| 9 | Side Plate | 25 | Shaft of Mesh |
| 10 | Side Poros | 26 | Gear |
| 11 | Side Spacer | 27 | wesher |
| 12 | Side Spacer Step | 28 | Coupling Flexible |
| 13 | Bearing Units | 29 | Pen |
| 14 | Cover Bearing Units | 30 | Gear Box |
| 15 | Back Plate | 31 | Electrical Motor |
| 16 | Hopper | 32 | Bolt Inbus M10 |

Wong, J.H., Karen, W.M.J., Bahrin, S.A., Chua, B.L., Melvin, G.J.H. and Siambun, N.J., 2022. Wear Mechanisms and Performance of PET Shredder Blade with Various Geometries and Orientations. Machines, 10(9), p.760.

## PERFORMANCE DETAILS



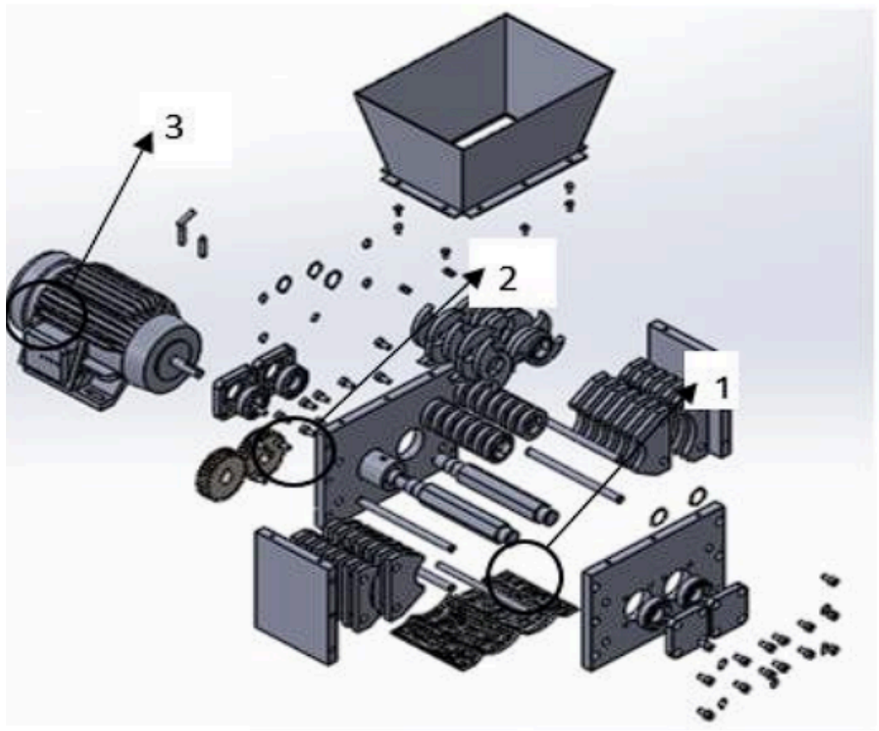
**Working Mechanism:**

- **Loading:** Bottles are loaded into the hopper.
- **Processing:** The cutters grab onto the bottles, applying tensile force to stretch and position the material before shear forces are applied to cut them into smaller pieces.
- **Collection:** The shredded plastic is then collected for further recycling or disposal.Motor

**Motor capacity :**

It is an electrical motor with a reduction gearbox. This implies that the machine is designed to handle moderate to heavy-duty tasks like shredding **PET** bottles, which typically require motors in the range of **350 to 600** watts or higher, depending on the load and operational speed needed

.




Wong, J.H., Karen, W.M.J., Bahrin, S.A., Chua, B.L., Melvin, G.J.H. and Siambun, N.J., 2022. Wear Mechanisms and Performance of PET Shredder Blade with Various Geometries and Orientations. Machines, 10(9), p.760.

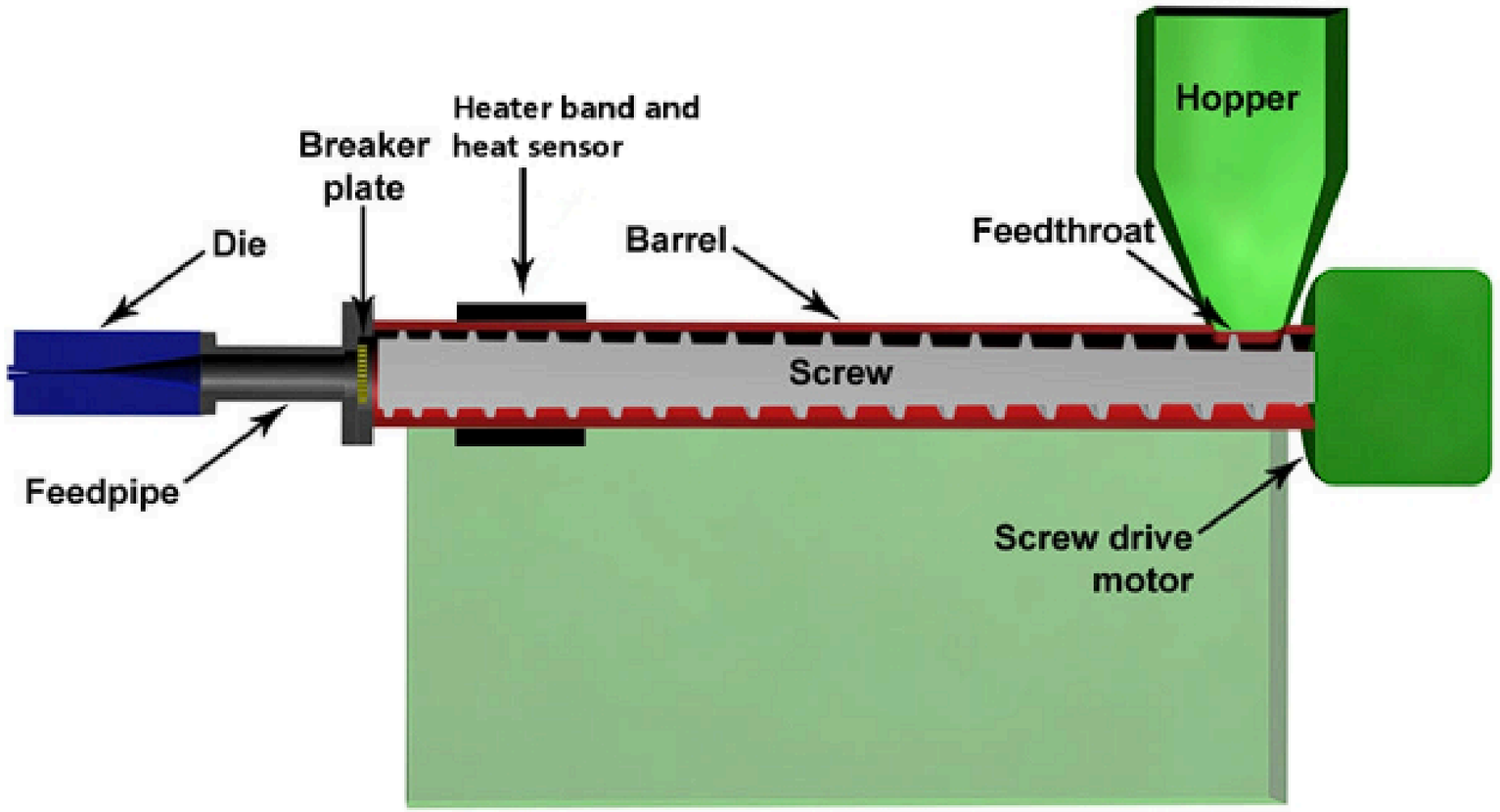



**Figure 3.7** Schematics of a generic single screw extruder. [*Wikipedia. Plastic extrusion*]

Lilja, P. and Sola Merino, J., 2015. Calibration of gantry-tau robot and prototyping of extruder for 3d printing.

**Figure 2. The HDPE 3D printing effector mounted to the robotic arm. Shredded HDPE plastic from recycled sources is fed into the hopper and extruded during printing.**

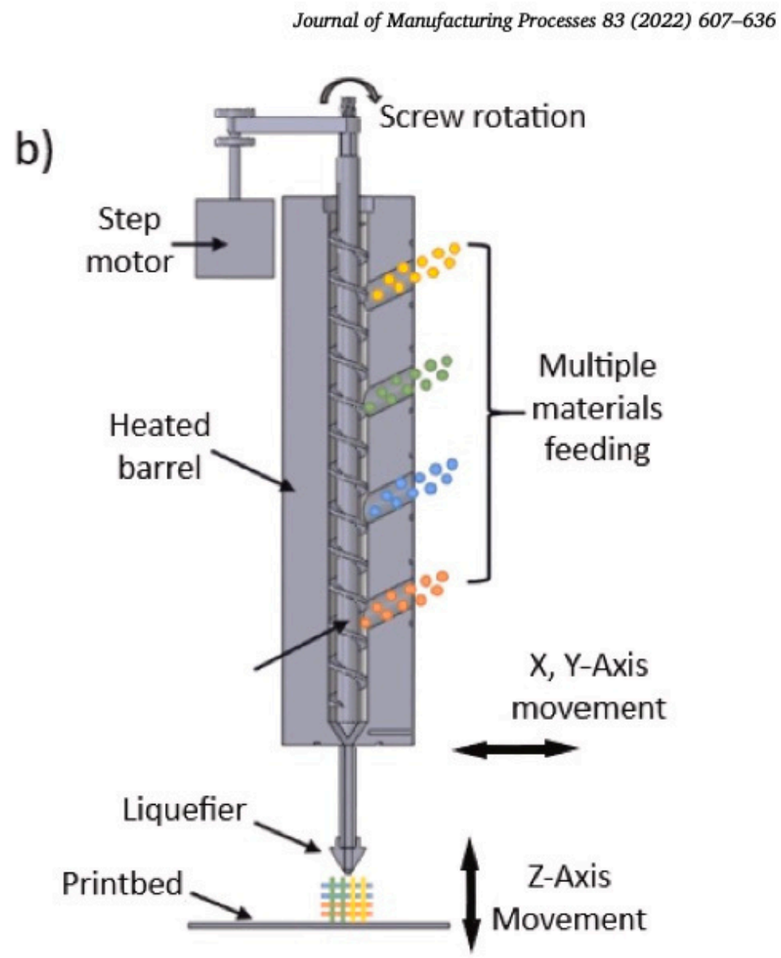
Keating, S. and Oxman, N., Compound Fabrication: A MultiaFunctional.

# Exploring Different Types of End Effectors to Build Our System

# EXTRUSION-BASED ADDITIVE MANUFACTURING TECHNOLOGIES: STATE OF THE ART AND FUTURE PERSPECTIVES

**Extrusion Process Overview:**

- **Step Motor & Screw Rotation**: The step motor drives the rotation of the screw, which is a key component in the extrusion process. This motor provides precise control over the screw's rotation speed, allowing for consistent extrusion of materials.
- **Heated Barrel:** As the screw rotates, it moves material through the heated barrel. The heat reduces the viscosity of the material, turning it into a fluid-like state suitable for extrusion. The barrel's temperature is carefully controlled to ensure proper material flow.
- **Multiple Materials Feeding**: This particular design includes multiple material feeding ports at different points along the screw. This allows for the simultaneous or sequential feeding of different materials, which can be mixed as they are pushed along the screw towards the liquefier.
- **Screw Conveyance and Mixing:** The screw design, including its spiral grooves, helps move and mix the materials as they travel down the barrel. The mixing of different materials can produce composite or multi-material parts.
- **Liquefier:** At the bottom of the barrel, the materials pass through a liquefier, where they are fully melted and prepared for deposition.
- **Extrusion and Deposition:** Once the materials are fully melted and mixed, they are extruded through a nozzle onto a print bed. The print head and nozzle move along the X, Y, and Z axes to deposit the material in layers, building the desired 3D shape.




) drill bit combined with spindle head [77], and (b) angular screw with four

ScienceDirect. (2022). Innovations in plastic extrusion systems. [online] Available at: https://www.sciencedirect.com/science/article/pii/S1526612522006521?via%3Dihub [Accessed 20 Nov. 2024].

# HANGPRINTER FOR LARGE SCALE ADDITIVE MANUFACTURING USING FUSED PARTICLE FABRICATION WITH RECYCLED PLASTIC AND CONTINUOUS FEEDING

**How the Machine Works:**

- Pellets enter the hopper and are fed into the extruder by gravity.
- The stepper motor rotates the auger, pushing the pellets through the steel barrel.
- The barrel heats the pellets, melting them as they move forward.
- The melted plastic is forced through the nozzle, which shapes it for printing.
- Cooling fans solidify the extruded plastic as it exits the nozzle, ready for use.

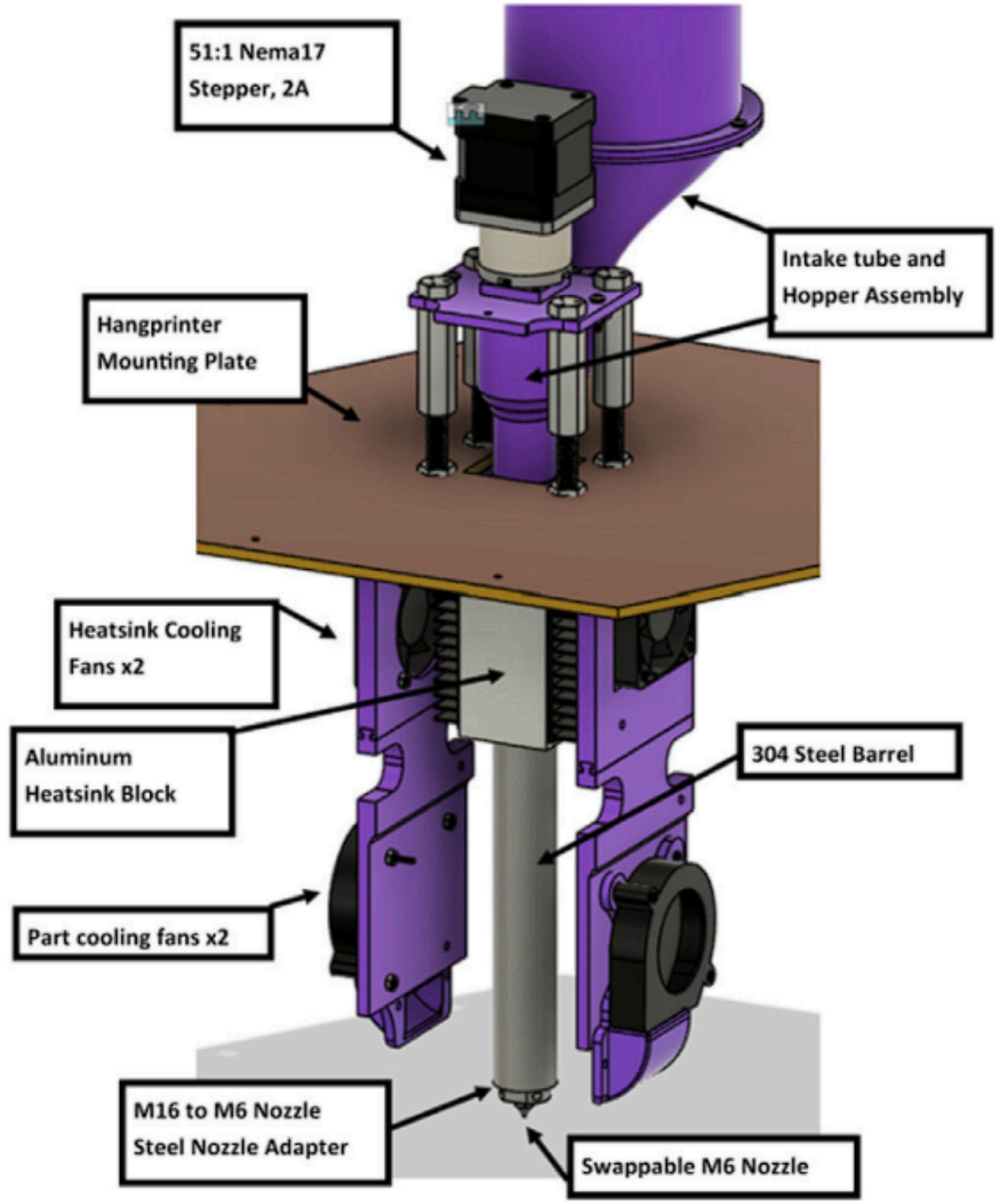



**Fig. 4.** Pellet extruder details.

Rattan, R.S., Nauta, N., Romani, A. and Pearce, J.M. (2023). Hangprinter for large scale additive manufacturing using fused particle fabrication with recycled plastic and continuous feeding. HardwareX, 13, p.e00401. doi:https://doi.org/10.1016/j.ohx.2023.e00401.

**Fig. 70.** Auger inserted into shaft coupling and motor.

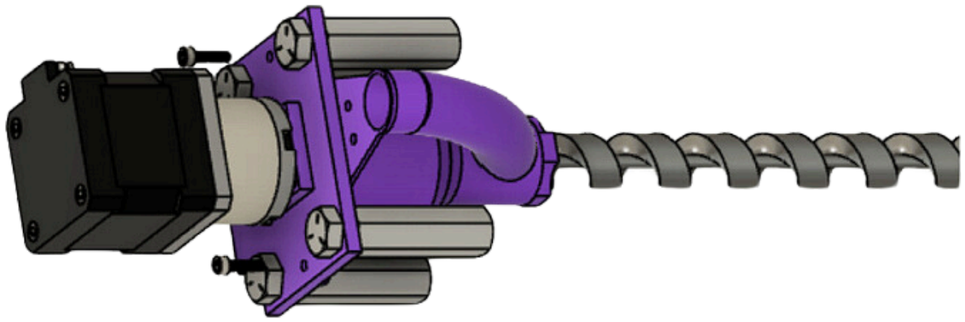


**Fig. 71.** Attaching the IntakeTube.

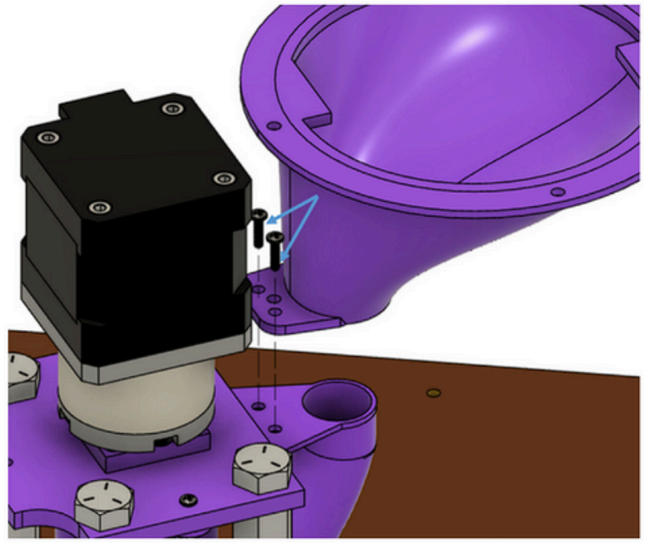


**Fig. 72.** Mounting the IntakeTube_Hopper.

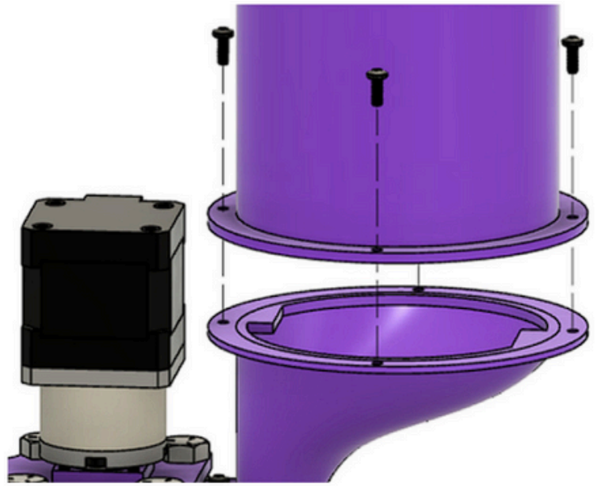
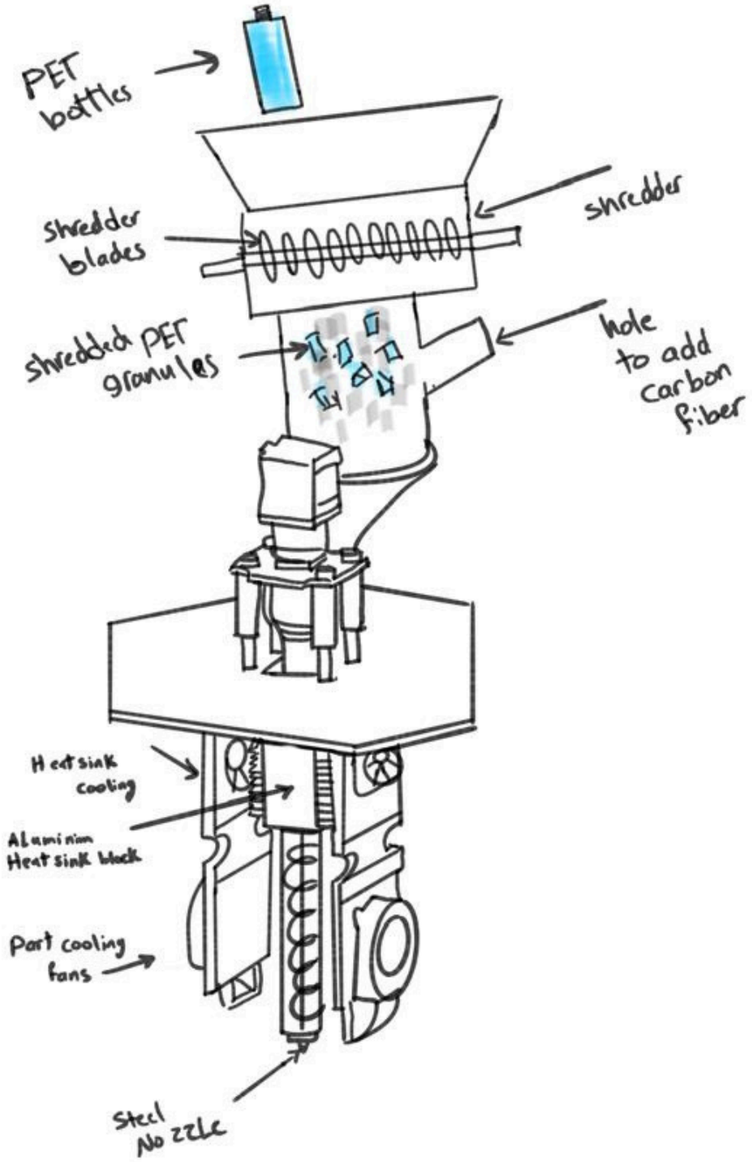


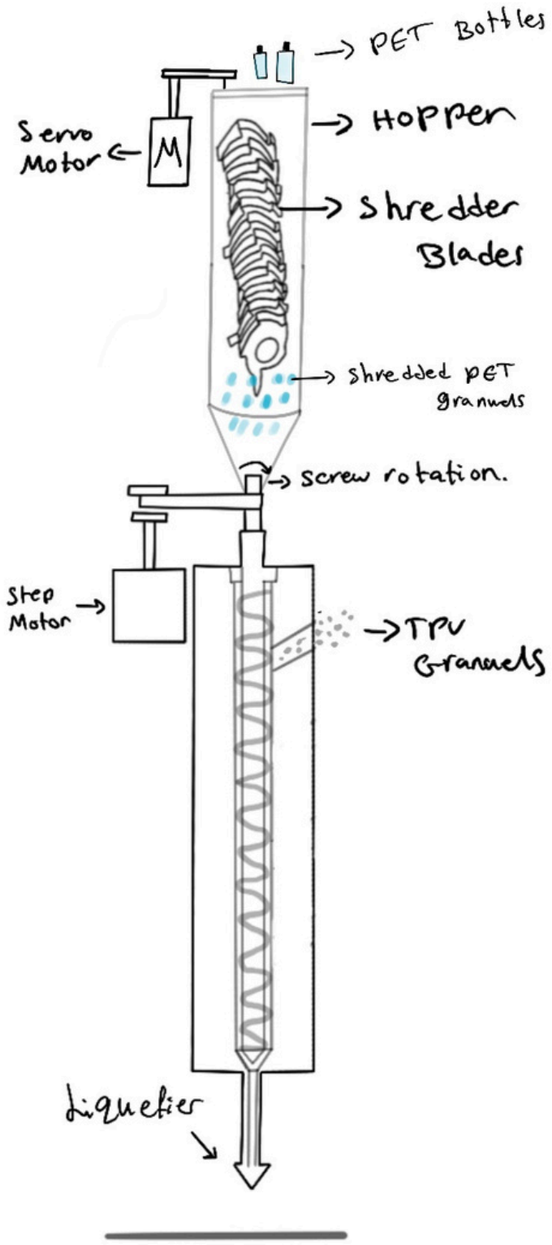
**Fig. 73.** Mounting the IntakeTube_Extension.

Rattan, R.S., Nauta, N., Romani, A. and Pearce, J.M. (2023). Hangprinter for large scale additive manufacturing using fused particle fabrication with recycled plastic and continuous feeding. HardwareX, 13, p.e00401. doi:https://doi.org/10.1016/j.ohx.2023.e00401.

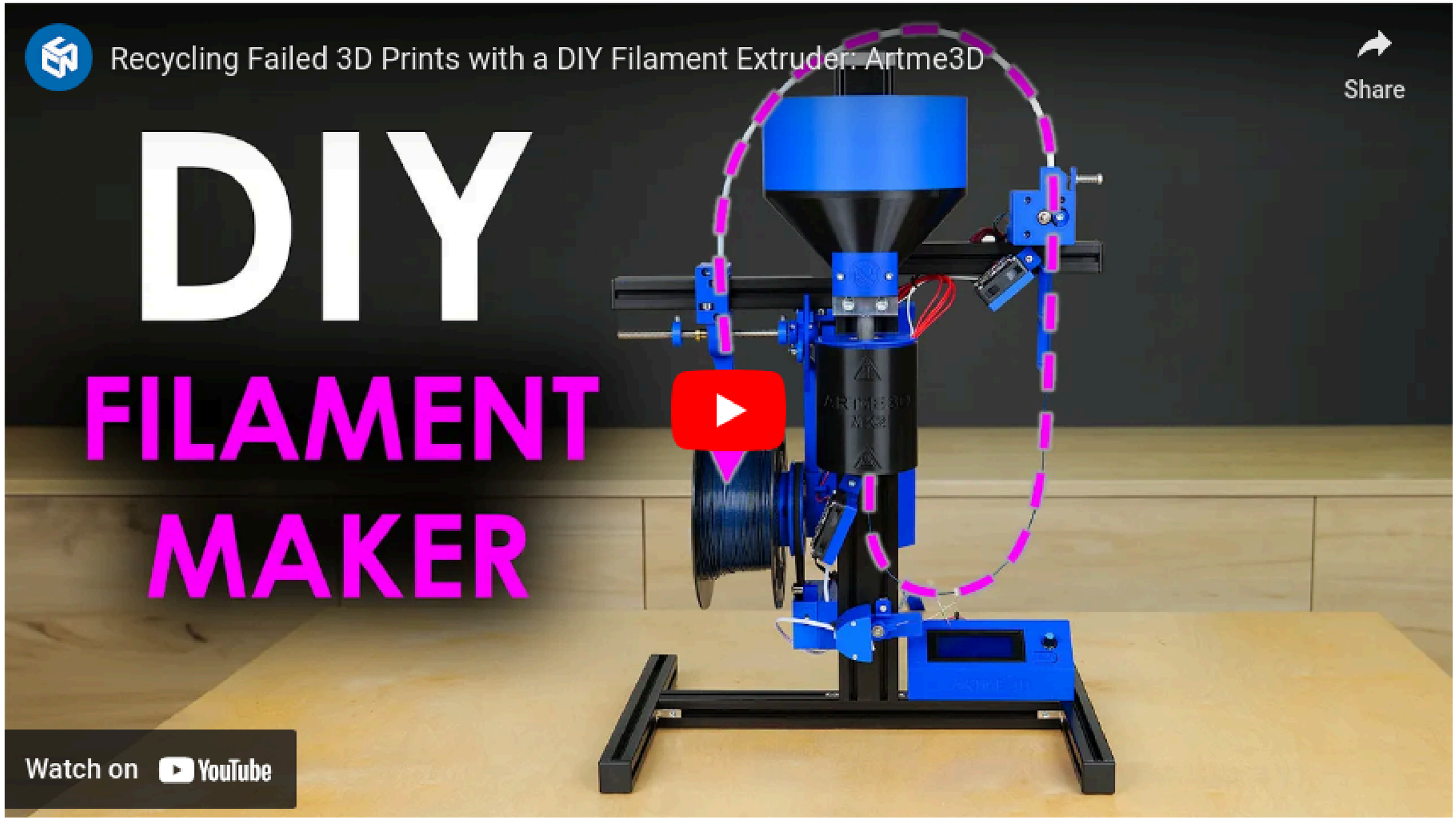
# Potential End Effector Sketches

## POTENTIAL END EFFECTOR SKETCHES



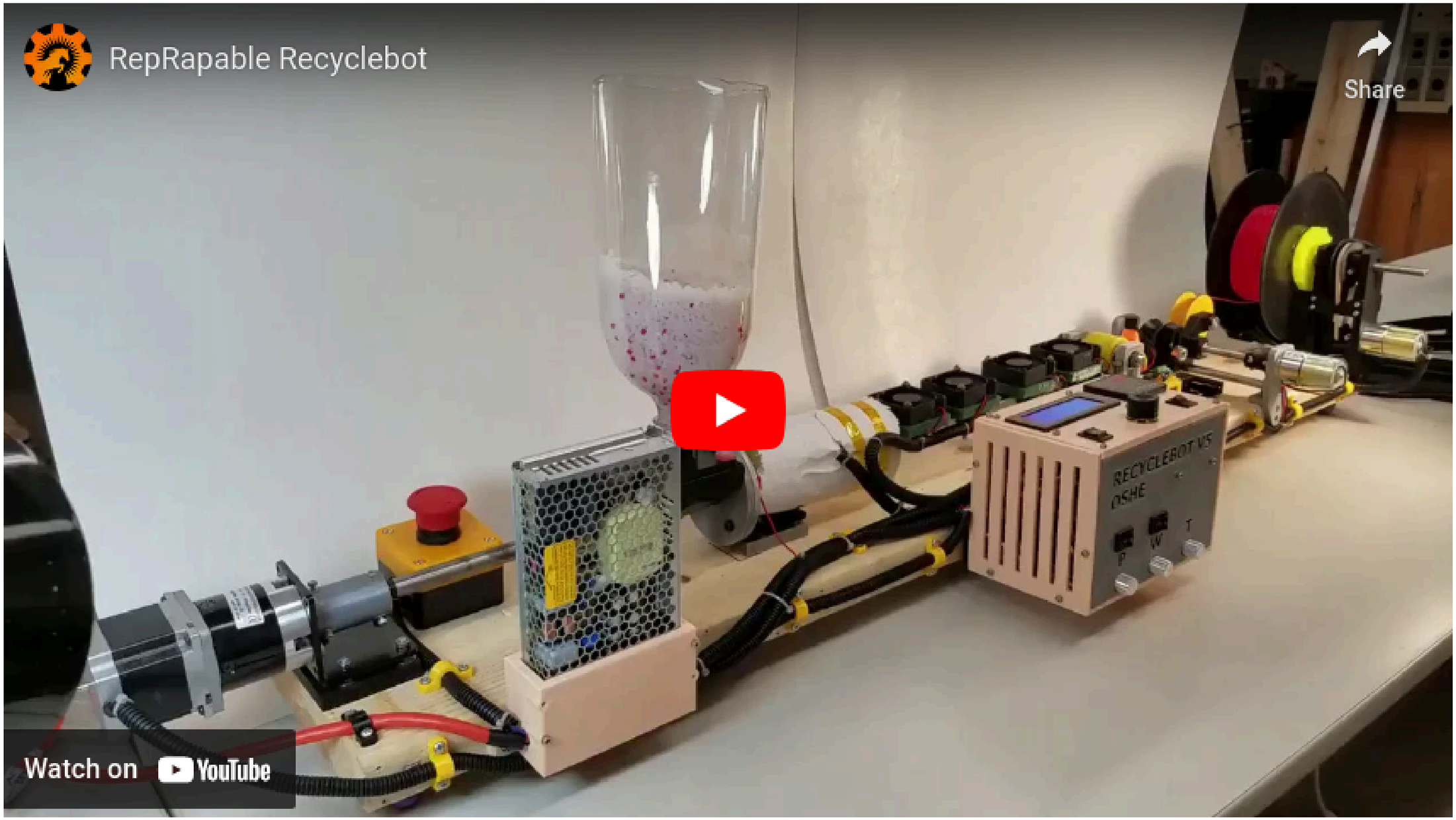



# Exploring DIY Plastic Extruder System Videos



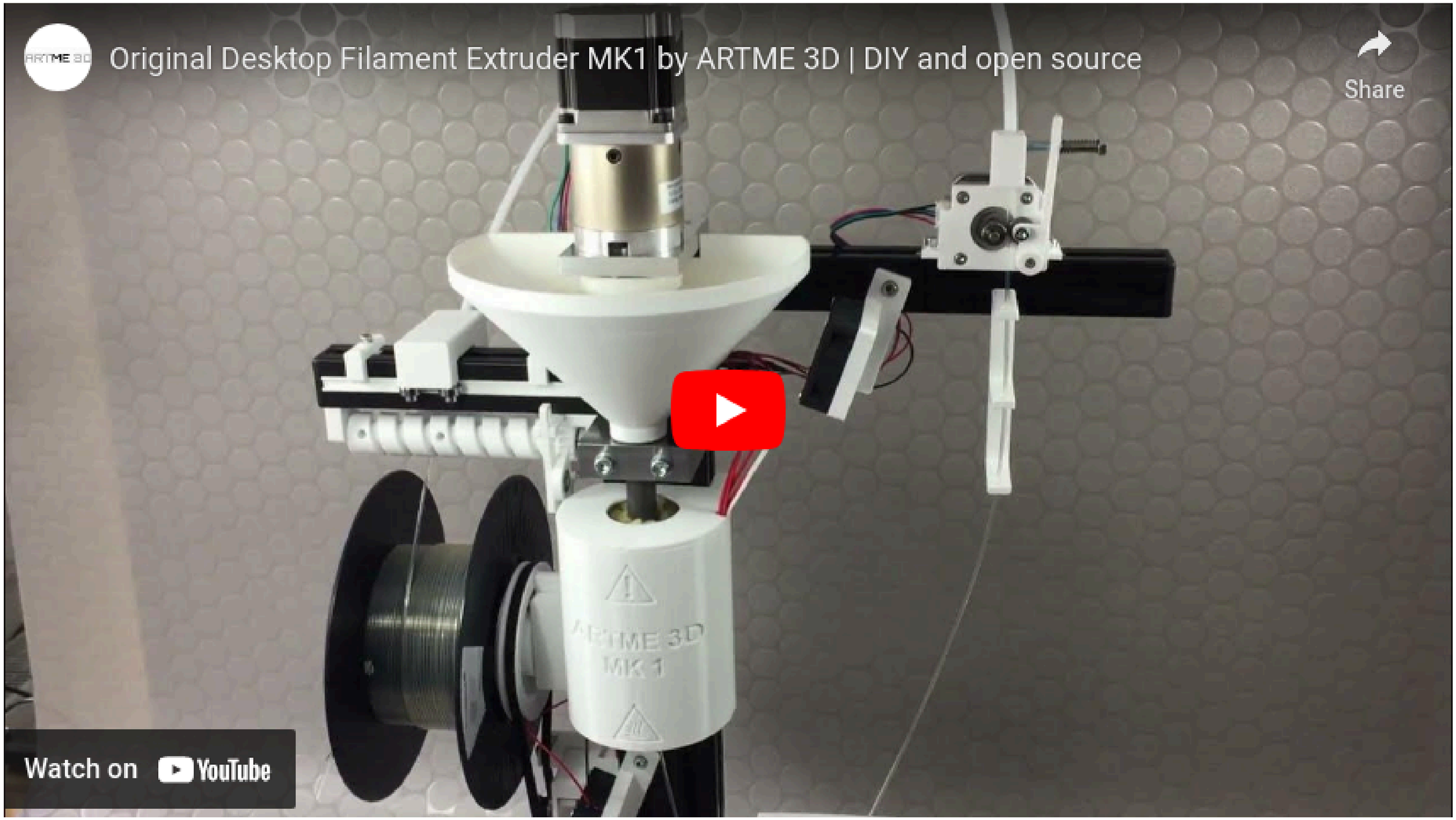

YouTube. (n.d.). Plastic flakes extrusion process. [video online] Available at: https://youtu.be/BT04gIGDjB4?si=yLuC1QAlvRtKpqZ8 [Accessed 20 Nov. 2024].

## REPRAPABLE RECYCLEBOT




YouTube. (n.d.). Extruder system prototype overview. [video online] Available at: https://youtu.be/b04mUaI-oTU?si=NSRepcZ_gu2eBRbE [Accessed 20 Nov. 2024].

## FILAMENT EXTRUDER MK1 BY ARTME 3D




YouTube. (n.d.). Shredded plastic transfer system demonstration. [video online] Available at: https://youtu.be/8uUWhh95LAk?si=dKOeCNzEU9QSncBD [Accessed 20 Nov. 2024].

# Replastify

# Building Our Plastic Recycling System

# The Vision

OUR VISION IS TO CREATE A SEAMLESS, **ALL-IN-ONE RECYCLING SYSTEM** THAT TRANSFORMS **PLASTIC WASTE INTO VALUABLE, INTRICATE DESIGN PRODUCTS** IN REAL TIME, DRIVING A SUSTAINABLE FUTURE THROUGH INNOVATIVE SIMPLICITY.

# The Concept

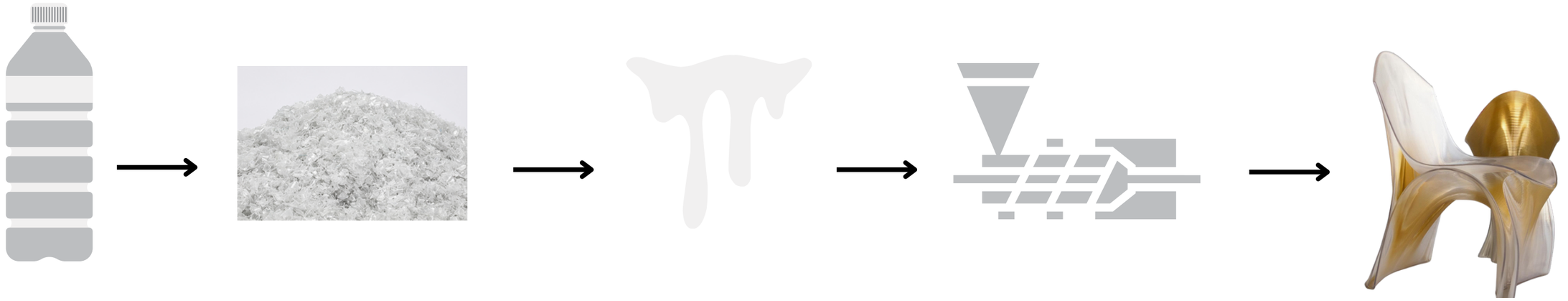
## The Concept

Our system is a compact, all-in-one recycling unit that seamlessly and automatically transforms discarded PET bottles into intricately designed products in a single, automated process.

# How The Systems Works

## How The Systems Works

The bottles are introduced into the system through a unique air-pressure pipeline that ensures smooth, continuous feeding into the shredder, where they are processed into flakes. These flakes are then immediately extruded to form complex, functional designs, creating a seamless, on-demand production cycle. This closed-loop recycling system drastically reduces both time and costs, while enhancing sustainability and usability across multiple industries



Bottle Input

Shredding

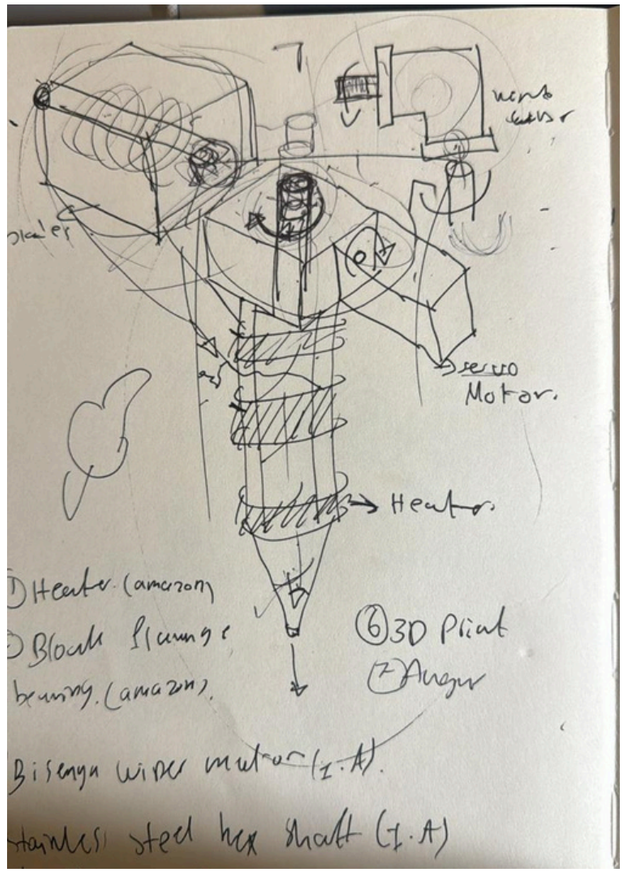
Melting

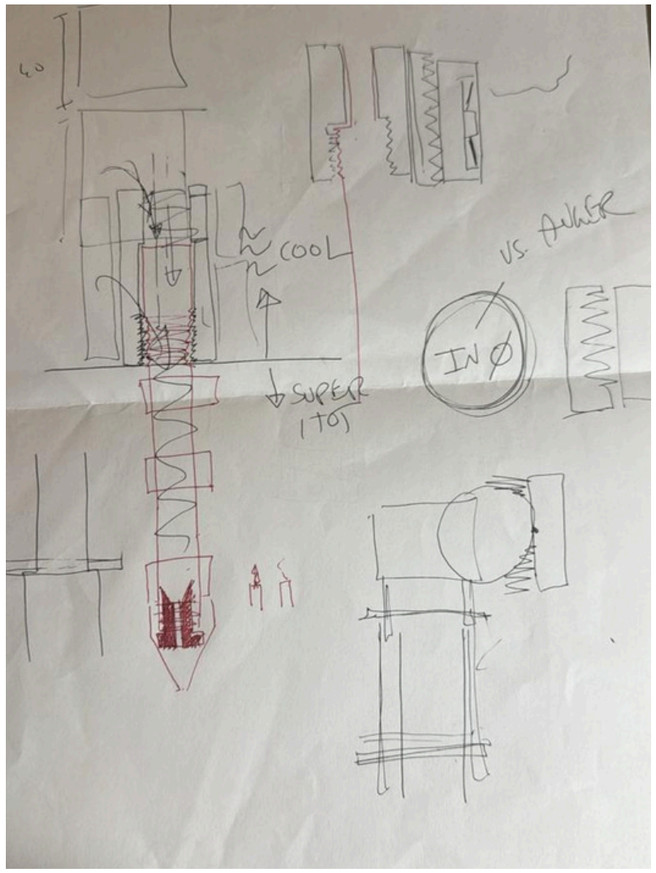
Extrusion

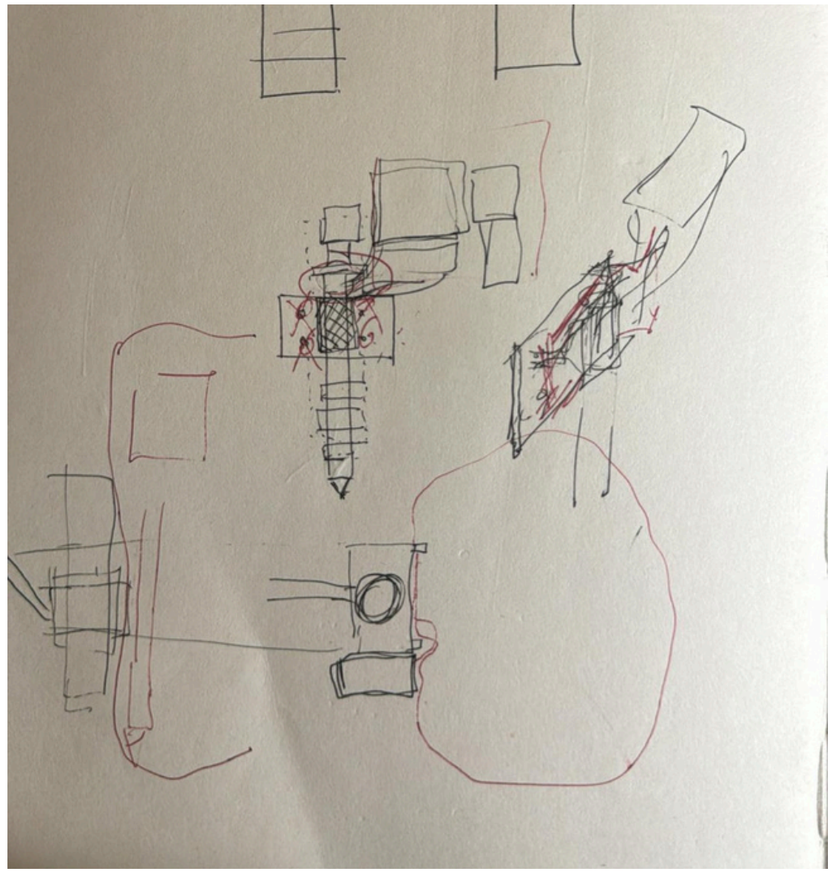
Product Creation

# Our Extruder System Iterations

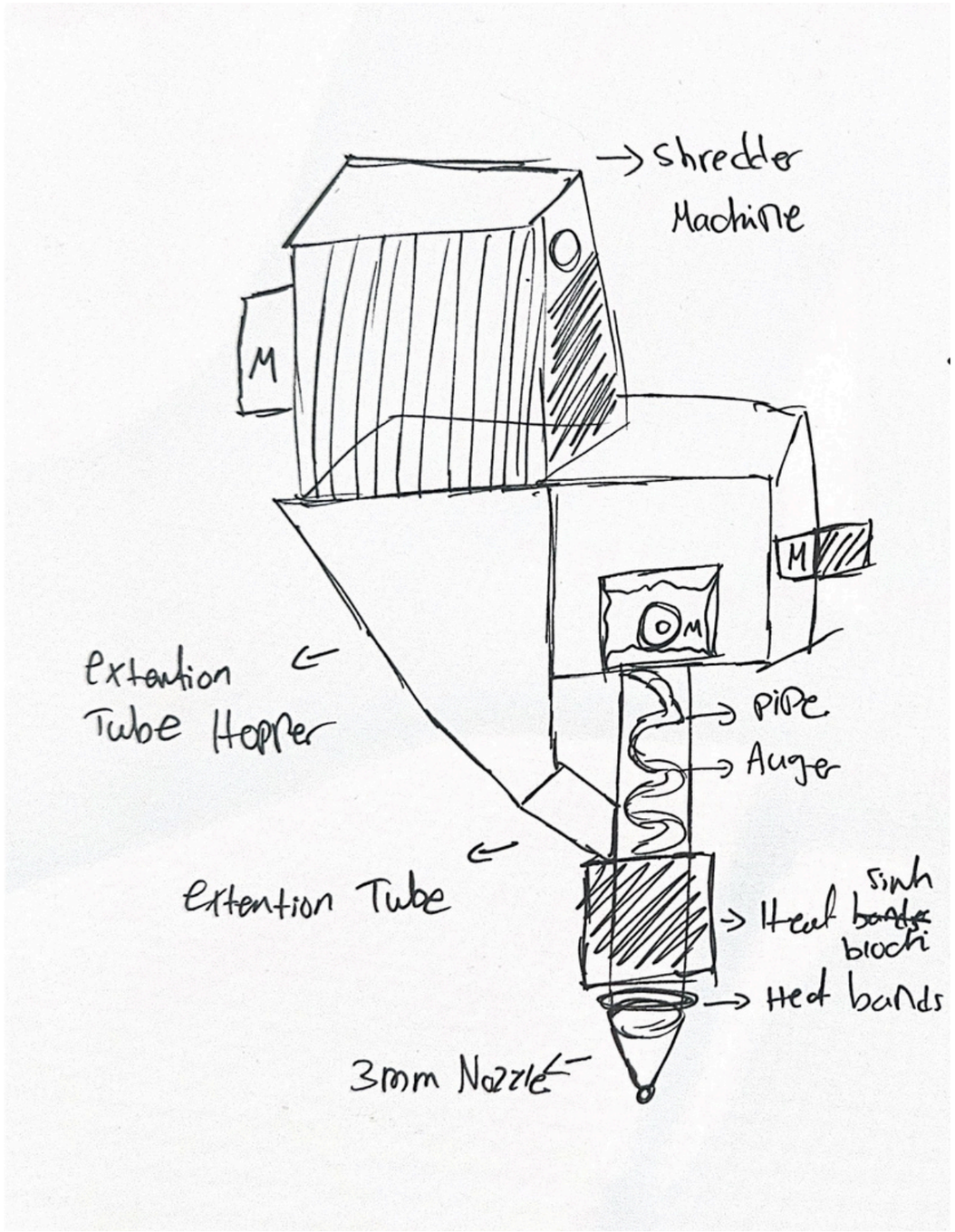
# Initial Recycling System Sketches



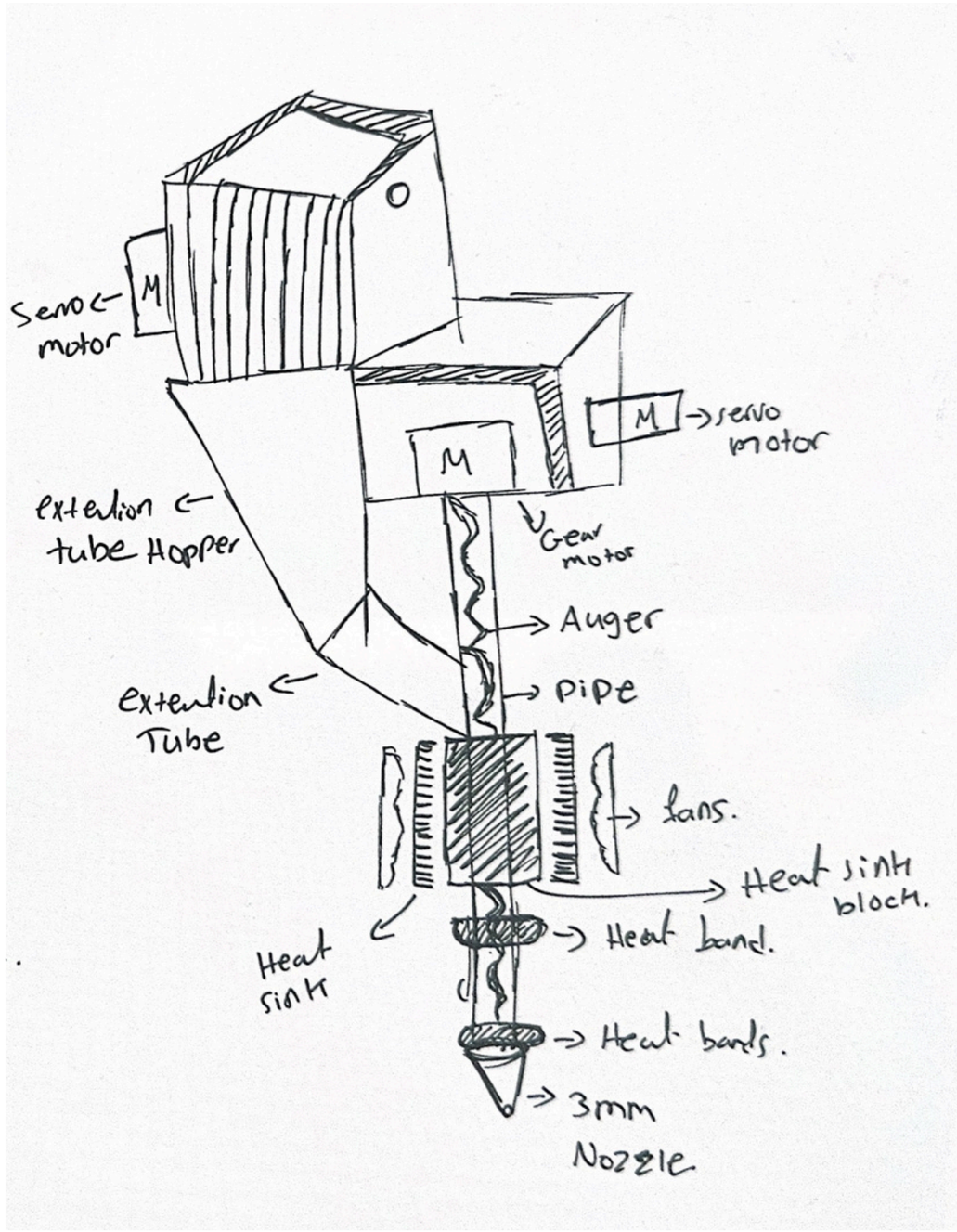



## Initial Recycling System Sketches

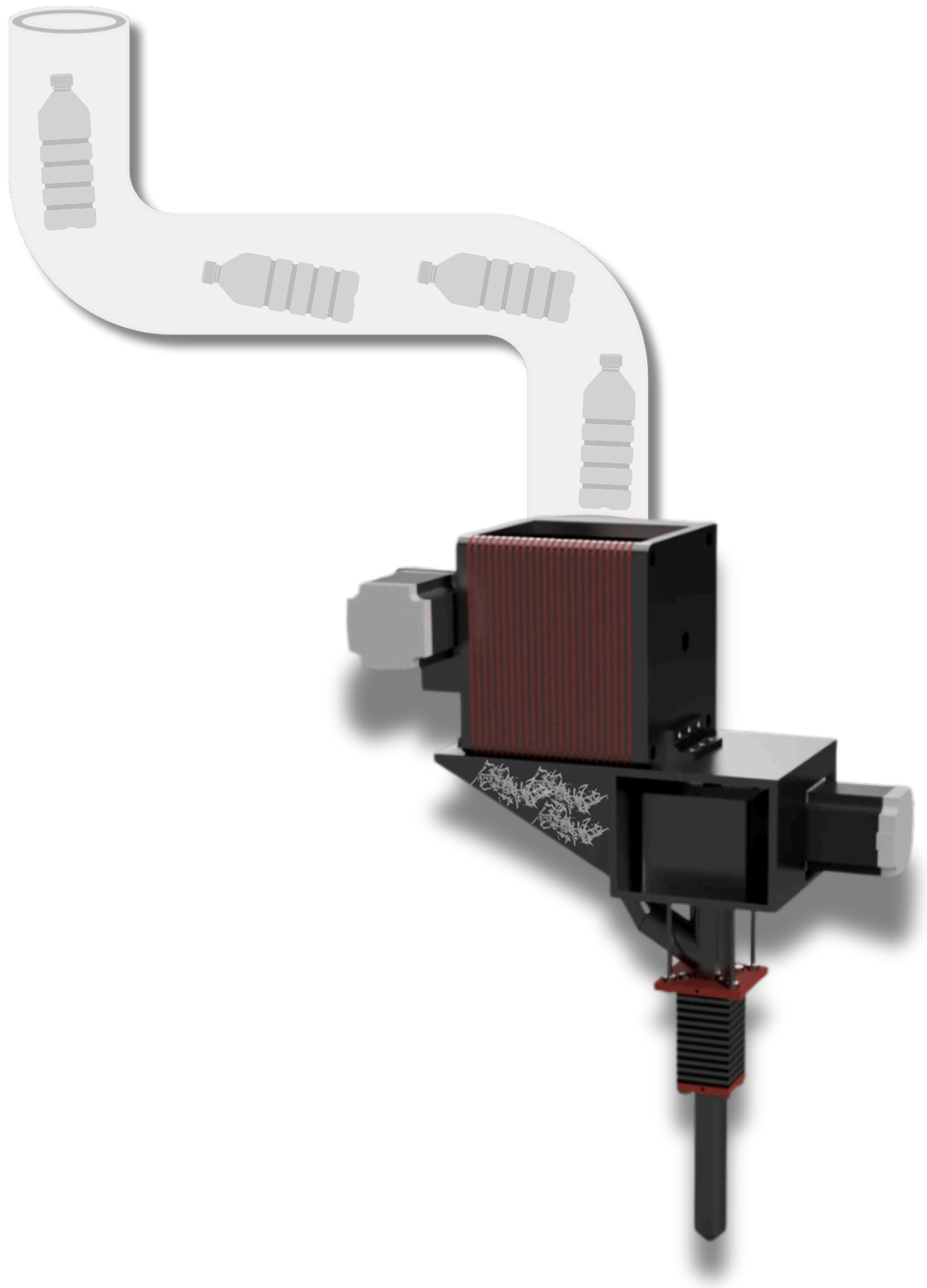


# Initial Recycling System Sketches

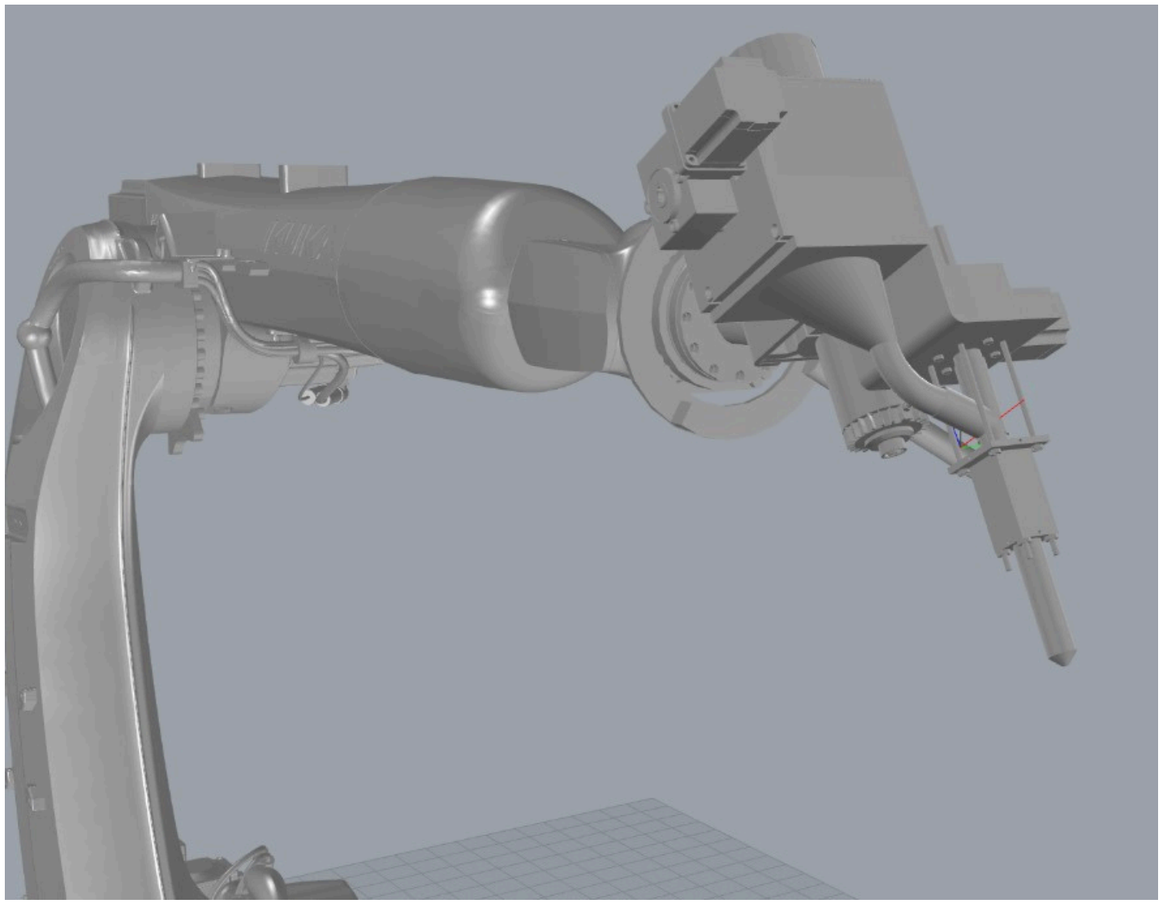


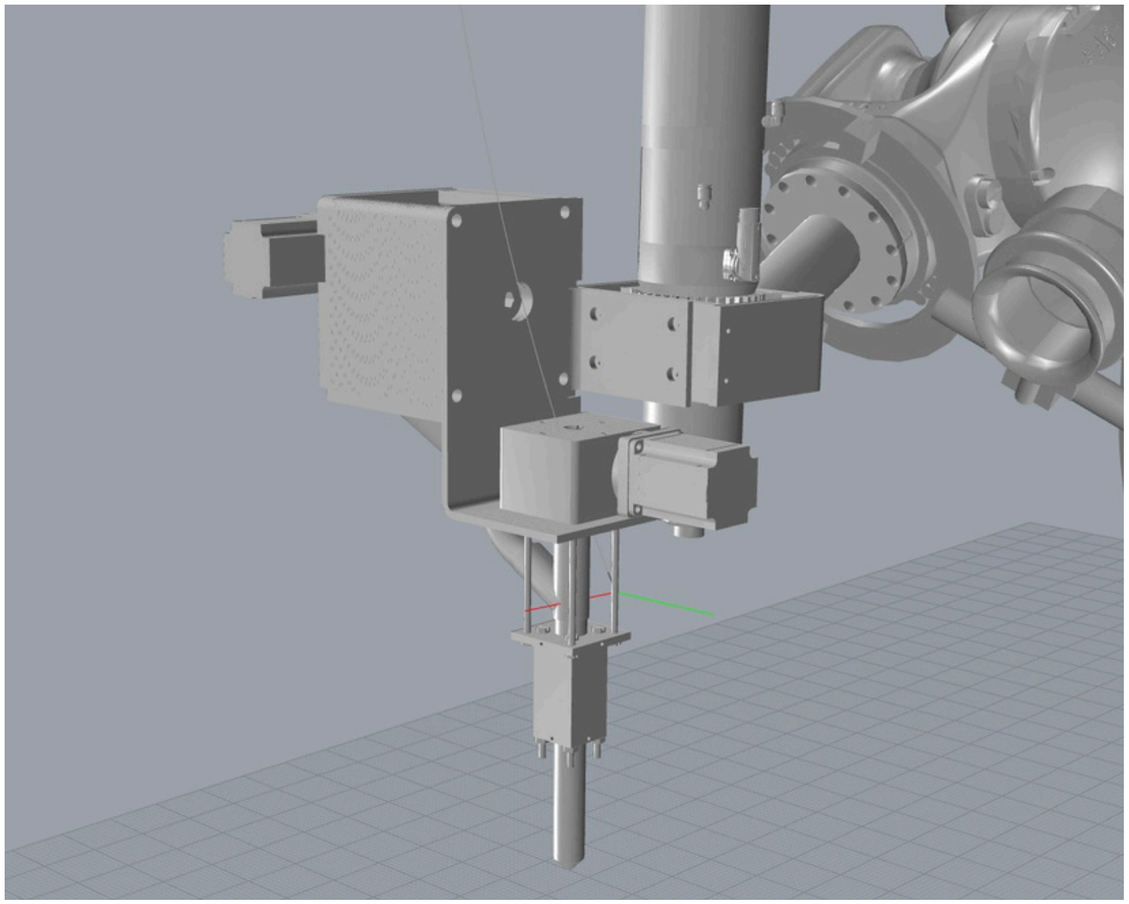
## Why using the robotic arm

- **Single-Unit Automation:** Combines shredder and extruder on a KUKA robotic arm, streamlining recycling from intake to finished product, eliminating extra machinery, and reducing labor.
- **Efficient Bottle Feed System:** The air-pressure pipeline ensures smooth, continuous bottle feeding, maximizing throughput and minimizing downtime.
- **On-the-Spot Manufacturing**: Transforms PET bottles directly into end-use products, cutting transport needs and saving time and resources.
- **Closed-Loop Sustainability:** Integrates all steps in one robotic unit, reducing energy consumption and promoting a circular economy.
- **Cost and Space Efficiency:** Compact, all-in-one design lowers costs and the physical footprint, adaptable for diverse settings.
- **Precision and Customization:** Robotic precision enables tailored, intricate designs for industries from automotive to consumer goods.



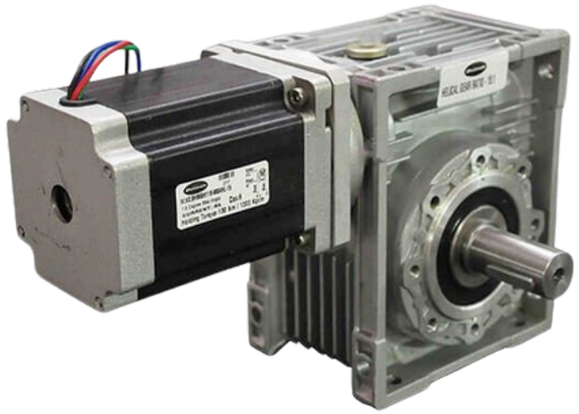
# Robot Attachement





# The Final End Effector Components (Recycling System)

## SHREDDER COMPONENTS



Stepper motor + Gear

Shredder (Metal with Shaft

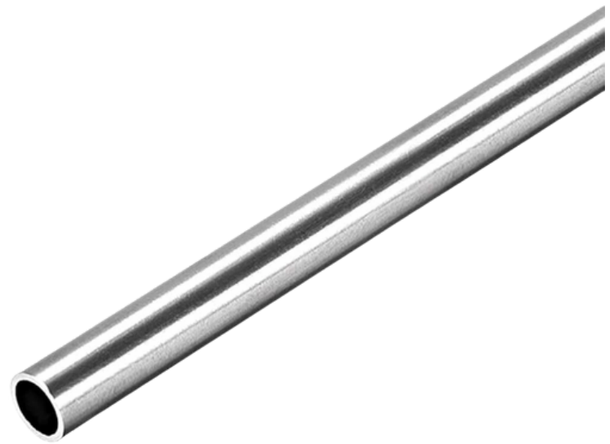
Block Flange Bearing

Shaft Stick 14mm

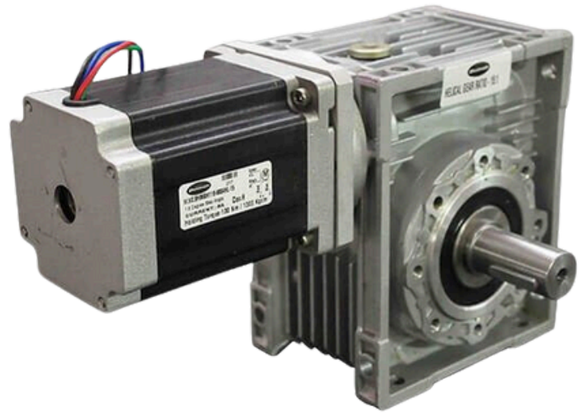
# EXTRUSION COMPONENTS

Heat Bands 25mm

Auger bit
20mm x 300mm

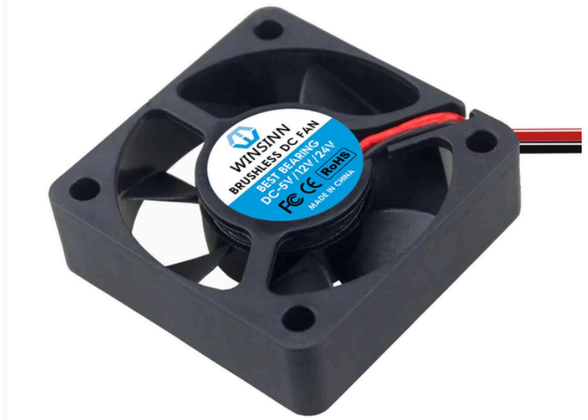


304 Stainless Steel Round Tube
OD: 25mm | ID: 20mm

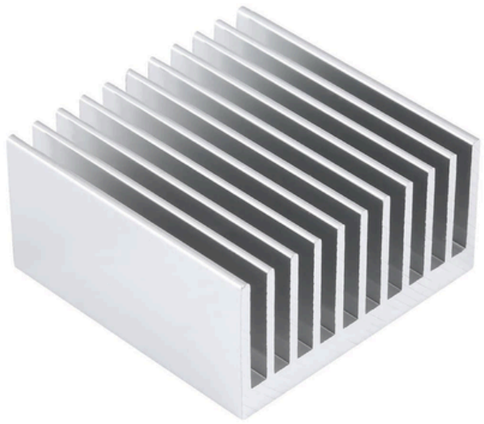


Stepper motor + Gear

# EXTRUSION COMPONENTS




WINSINN 50mm Fan 24V



Heatsink

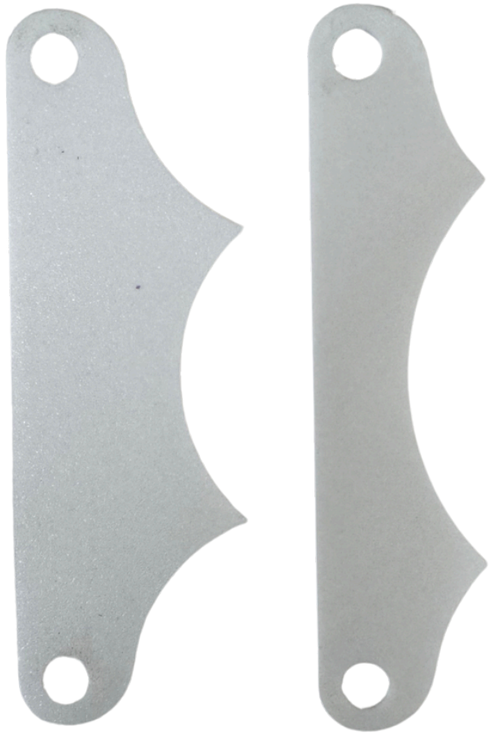

3mm Nozzle

# Iterations

## 3D Printed Shredder Blades

The shredder blades and knives are mounted onto the shredder machine, with each layer featuring a blade to shred plastic into small flakes efficiently. The final components will be made with metal

Shredder Blades

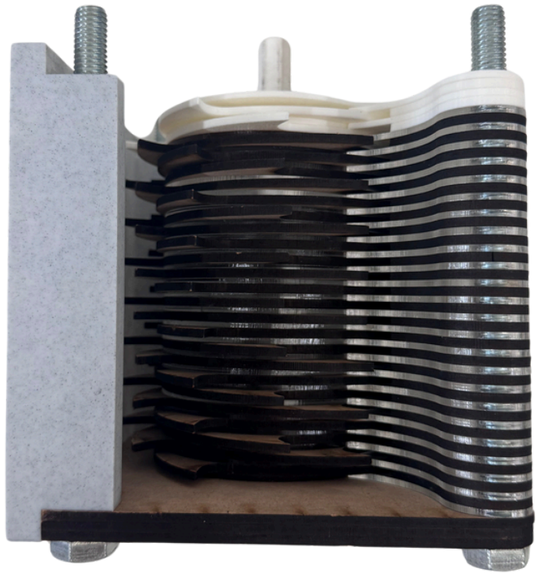


Shredder Knives

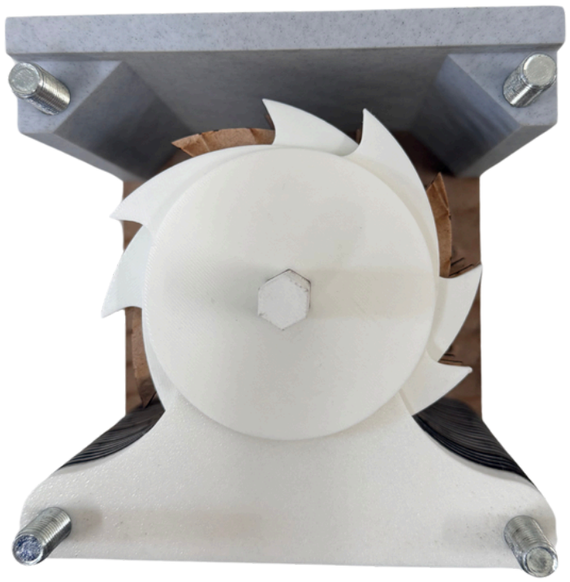
Shredder Blades

## Shredder Machine

The first prototype of our shredder machine was constructed using 3D-printed components and MDF. However, the final prototype will be entirely made of metal and will feature 15 shredder blades, including three different types of blades, to efficiently shred plastic into small flakes. These flakes will then be directed straight to the intake extrusion hopper.



Shredder Machine Side View

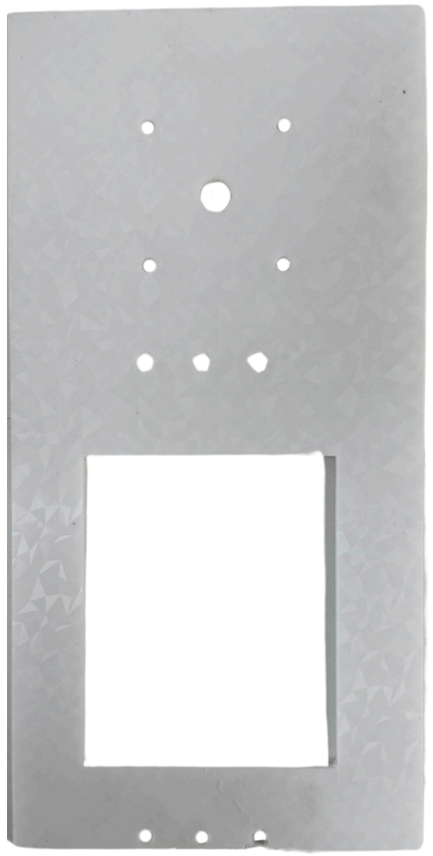


Shredder Machine Top View

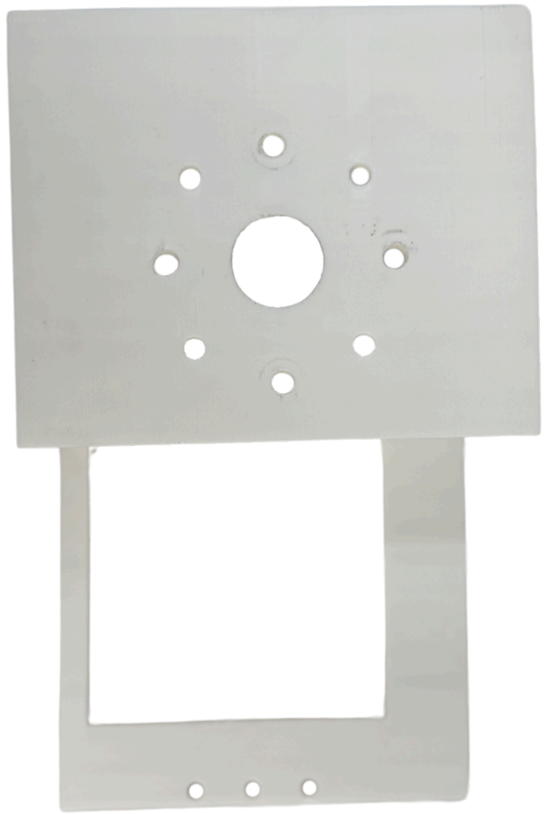
The first 3D printed prototype of the Stepper Motor Holder for shredder

## Robot Attachement

In the second prototype of the holder, we improved the design by repositioning the extruder to a lower position. This adjustment allows for easier attachment of the intake tube, enabling the smooth transfer of shredded flakes without sticking, as demonstrated in the plastic extruder system prototype.



First prototype of the holder for the shredder and the extruder



The second prototype of the holder for the shredder and the extruder (Front View)

The second prototype of the holder for the shredder and the extruder (side view)

## 3D Printed Intake Tube Hopper

The first prototype of the intake tube hopper is designed to transfer shredded plastic flakes from the shredder to the aluminum extrusion pipe for the extrusion process.

Intake Tube Hopper Top View

Intake Tube Hopper Side View

Intake Tube Extension

## Pipe Extruder

We tested three pipes and found Pipe 3 (Aluminum Alloy, OD: 25 mm, ID: 20 mm) ideal for our extruder. It provides enough space for the auger, fits heat bands efficiently, and ensures smooth plastic flow to the 3 mm nozzle, integrating all functions into one effective design.

**Pipe 1**

**Stainless steel**

**OD: 18 mm | ID: 15.6 mm**

**Pipe 2**

**Stainless Steel**

**OD: 20 mm | ID: 17 mm**

**Final Pipe**

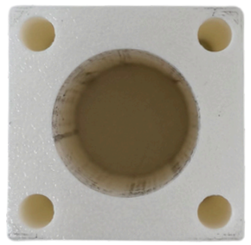
**Aluminium Alloy pipe**

**OD: 25 mm | ID 20mm**

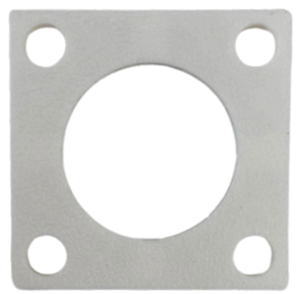
## 3D printed Heat Sink Prototype

The heat sink block is designed to absorb heat and is placed within the pipe to prevent the heat from reaching the upper part of the extruder.

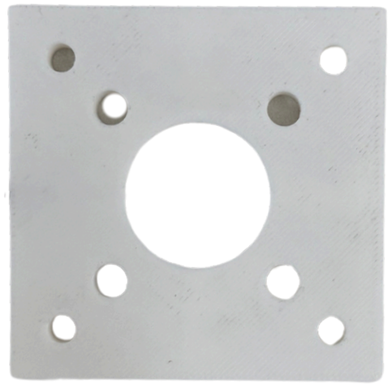
Heat Sink Block
side View



Heat Sink Block
Top View



Heat Sink
Bottom Holder



Heat Sink Top
Holder

# Extruder Components

Heat Bands of extruder

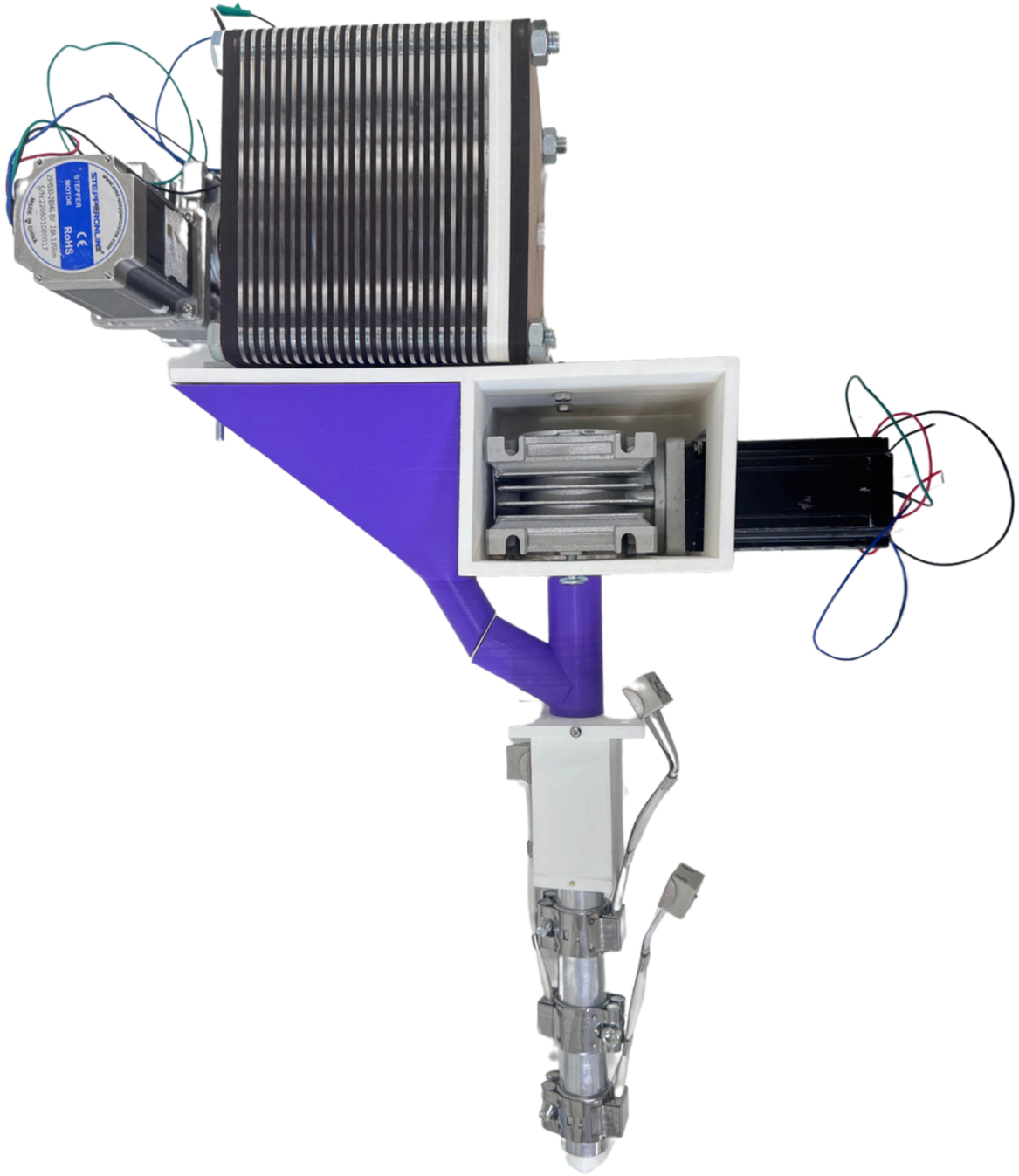
pipe 25mm

3D printed prototype of

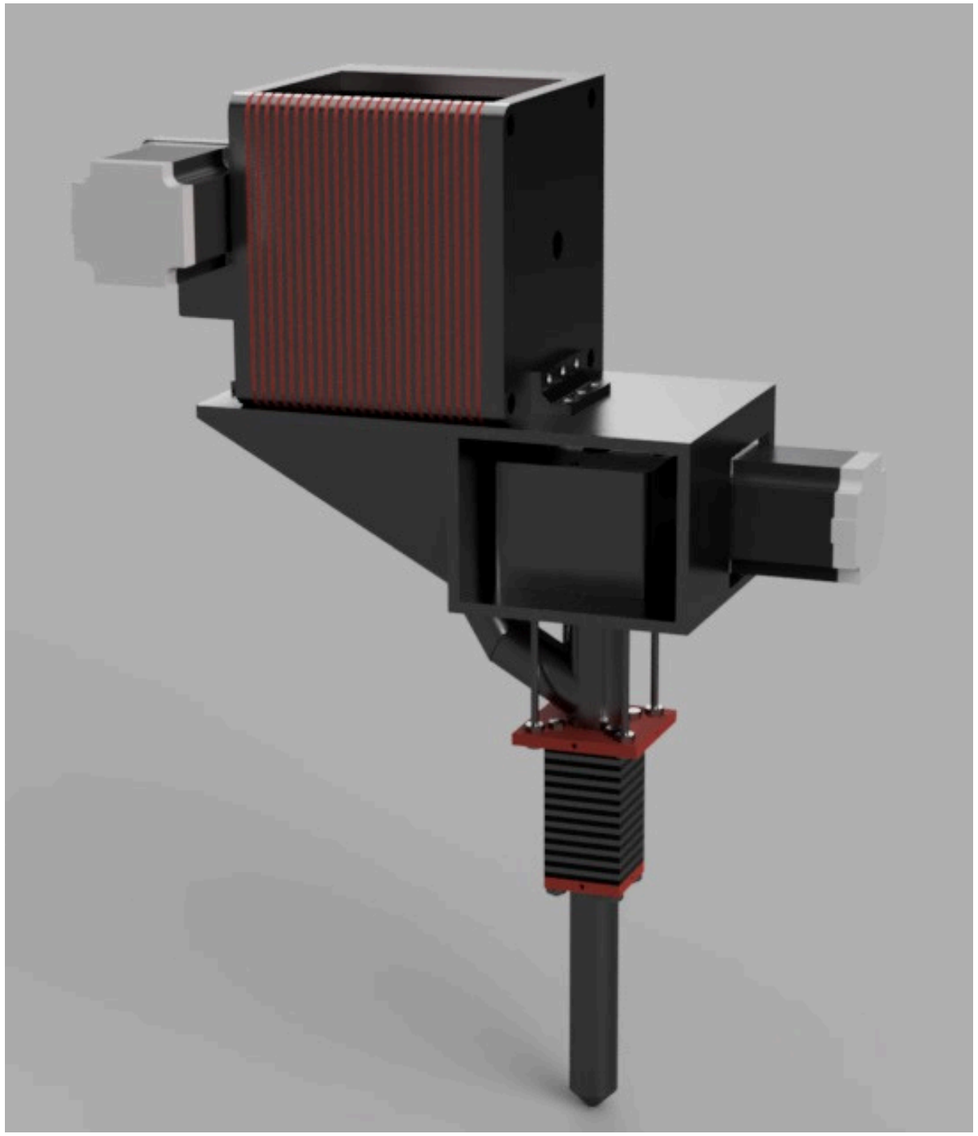
3mm Nozzle extruder

## Plastic Extruder System Prototype

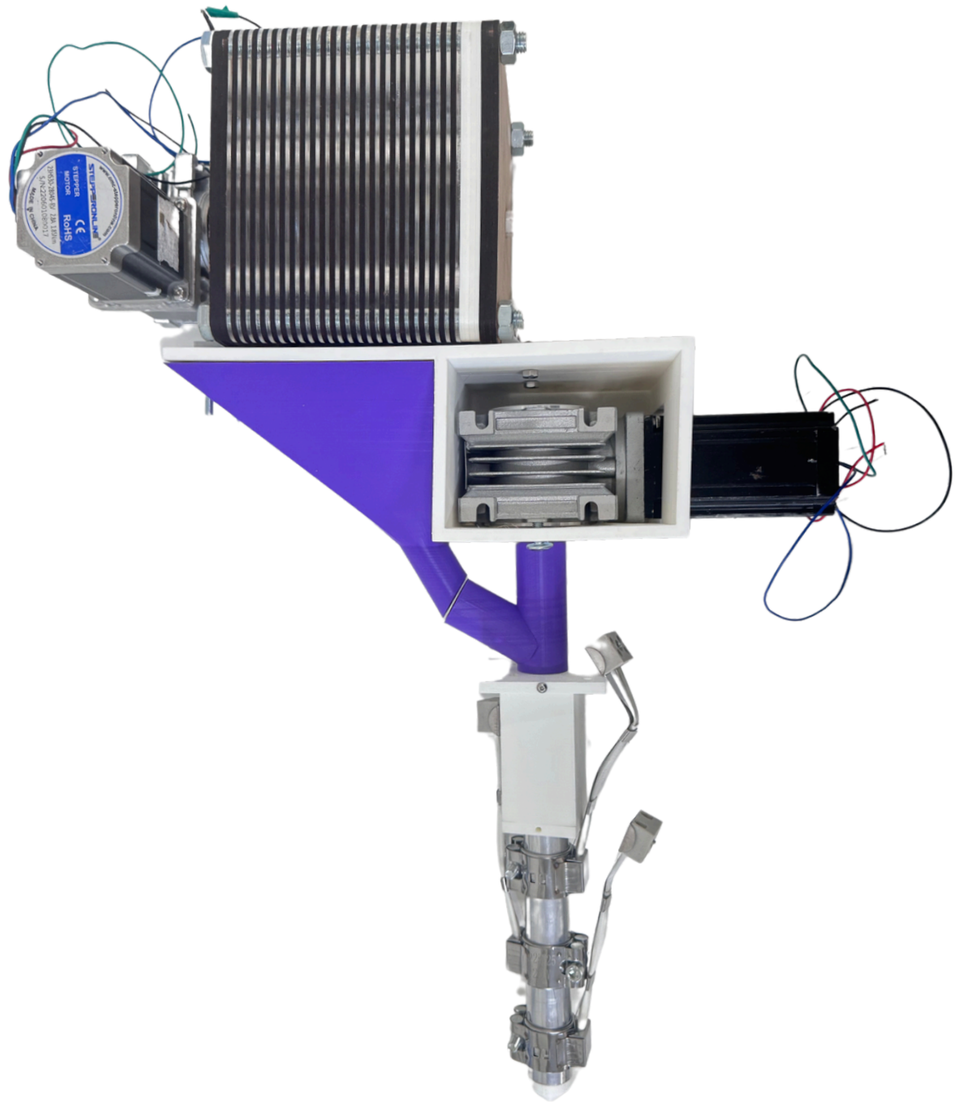
This is our first initial prototype, and there are several aspects that need to be improved for the final version. These include redesigning the intake tube, optimizing the hopper, and incorporating an air pressure pipe. Additionally, some components will be upgraded and manufactured using metal for enhanced durability and performance.



# Recycling Extruder System Prototype



Rendered Digital 3D Model



Physical Prototype Model

# Turning Plastic Waste into products

## Turning Plastic Waste into products

In the video "Turning Plastic Waste into 100% Recycled Tiles," the creators demonstrate their process of transforming post-consumer plastic waste into recycled plastic coasters, which can also serve as tiles.

The steps involved are:

https://www.youtube.com/watch?v=hEPAmGf-0i0&t=157s

**The steps involved are:**

1. Collection: Gathering used plastic materials, primarily milk bottles.
2. Cleaning and Drying: Thoroughly washing and drying the collected plastics to remove contaminants.
3. Sorting: Organizing the plastics by type and color to ensure uniformity in the final product.
4. Shredding: Using a shredding machine to break down the plastics into smaller pieces.
5. Injection Molding: Feeding the shredded plastic into an injection molding machine, which melts and injects the material into molds to form coasters or tiles.

## Turning Plastic Waste into products

In the video "Turning Plastic Waste into 100% Recycled Tiles," the creators demonstrate their process of transforming post-consumer plastic waste into recycled plastic coasters, which can also serve as tiles.

https://www.youtube.com/watch?v=hEPAmGf-0i0&t=157s

1. Collection: Gathering used plastic materials, primarily milk bottles.
2. Cleaning and Drying: Thoroughly washing and drying the collected plastics to remove contaminants.
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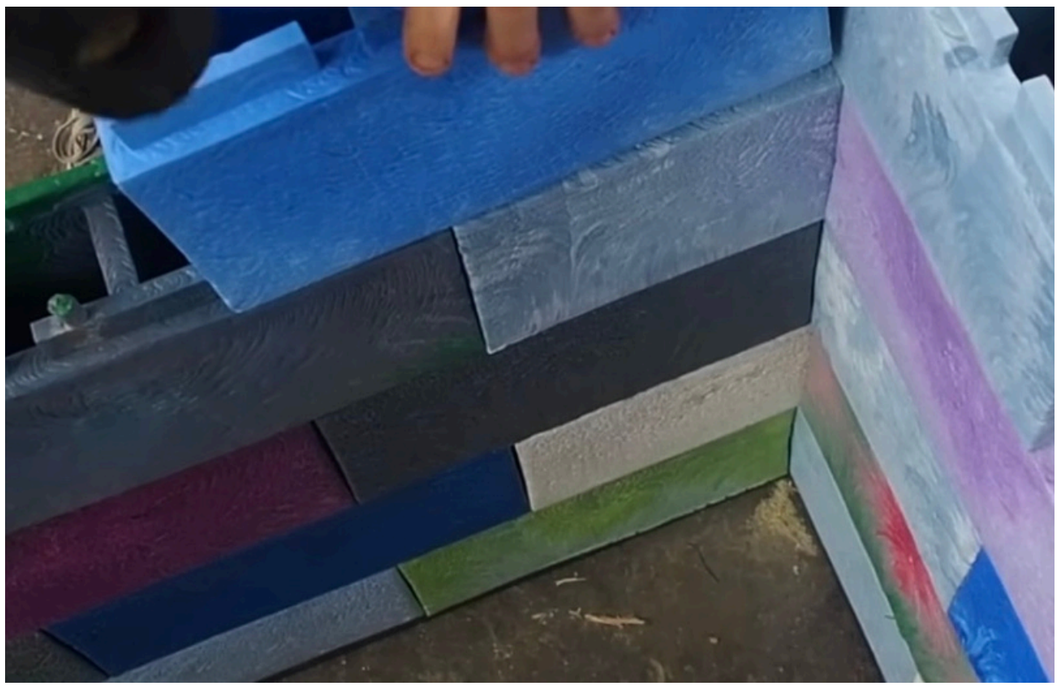
## Turning Plastic Waste into products

In the video "Recycled Plastic Bricks - Do They Work?" by The Wild Report, the creators explore the process of transforming plastic waste into construction bricks.



https://www.youtube.com/watch?v=hEPAmGf-0i0&t=157s

1. **Collection**: Gathering various types of plastic waste, including PET bottles and other discarded plastic items.
2. **Cleaning and Drying**: Thoroughly washing and drying the collected plastics to remove contaminants and moisture.
3. **Shredding**: Using a shredding machine to break down the plastics into smaller, manageable pieces.
4. **Melting**: Heating the shredded plastic in a controlled environment until it reaches a molten state.

# Potential Applications

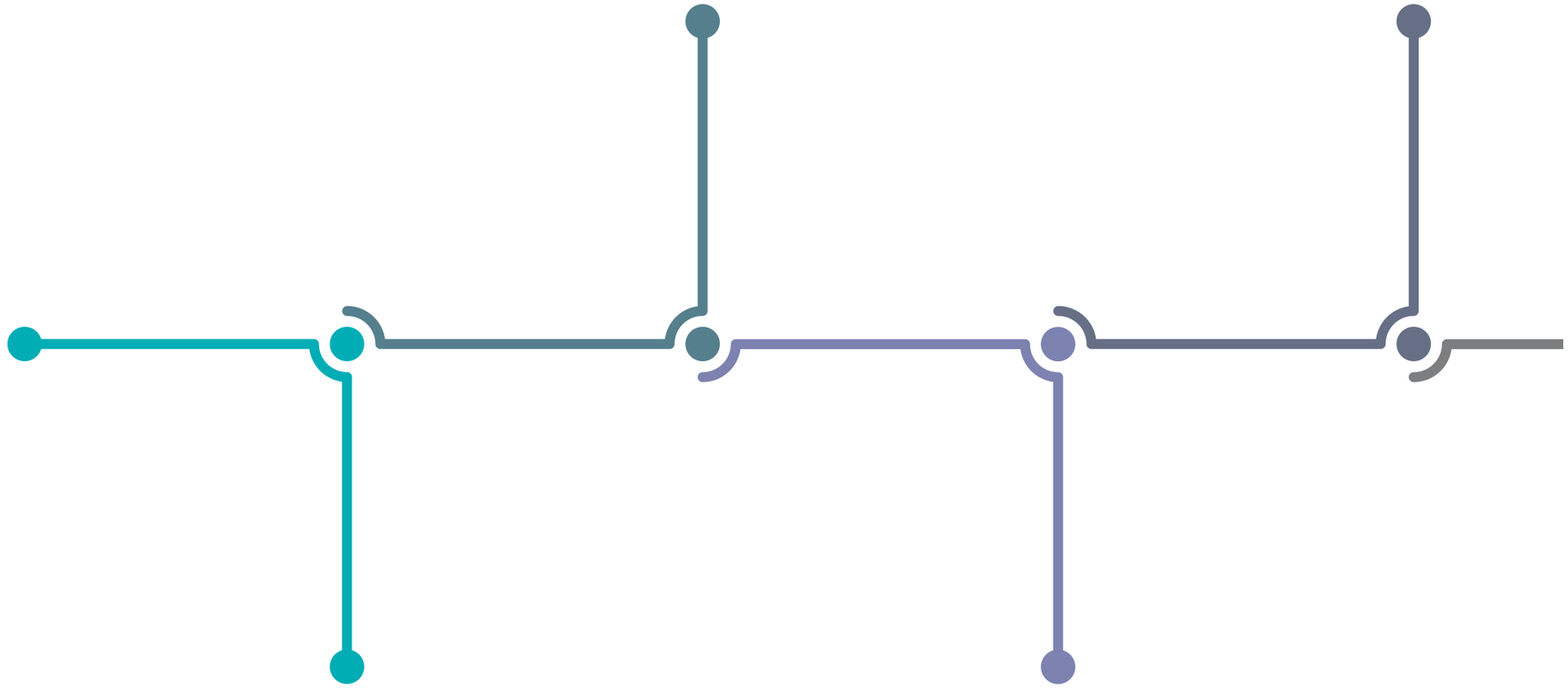
## Potential Applications

### Small – Medium Scale

- Vases
- Shoe
- Table Lamp
- Vases

### Large Scale

- Table
- Chairs
- facades
- Ceiling Lamp



### Small Scale

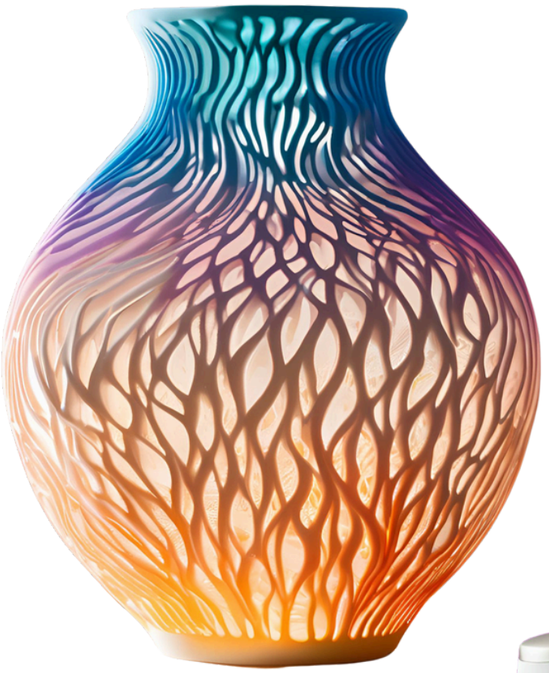
- Handbags
- Item Display
- Containers
- Packaging

### Medium – Large Scale

- 3D Organic Garment Structure

## Potential Applications Of The Plastic Recycling System

Our recycled system enables the transformation of PET plastic into versatile applications across various industries. Using advanced techniques, including a robotic arm for creating intricate designs, we produce sustainable and functional products. In the furniture industry, this includes chairs, tables, table lamps, vases, ceiling lamps, and display items. In fashion, it enables eco-friendly handbags, and in architecture, it supports innovative wall facades, ceiling sheets, 3D organic garment structures, and shoe uppers. By incorporating bottle caps, we achieve stunning gradient colors for enhanced aesthetics. In the future, expanding to materials like PP and HDPE could further diversify our range of sustainable designs.



Ai Generated Images

## Existed Potential Applications

### Furniture Industry:

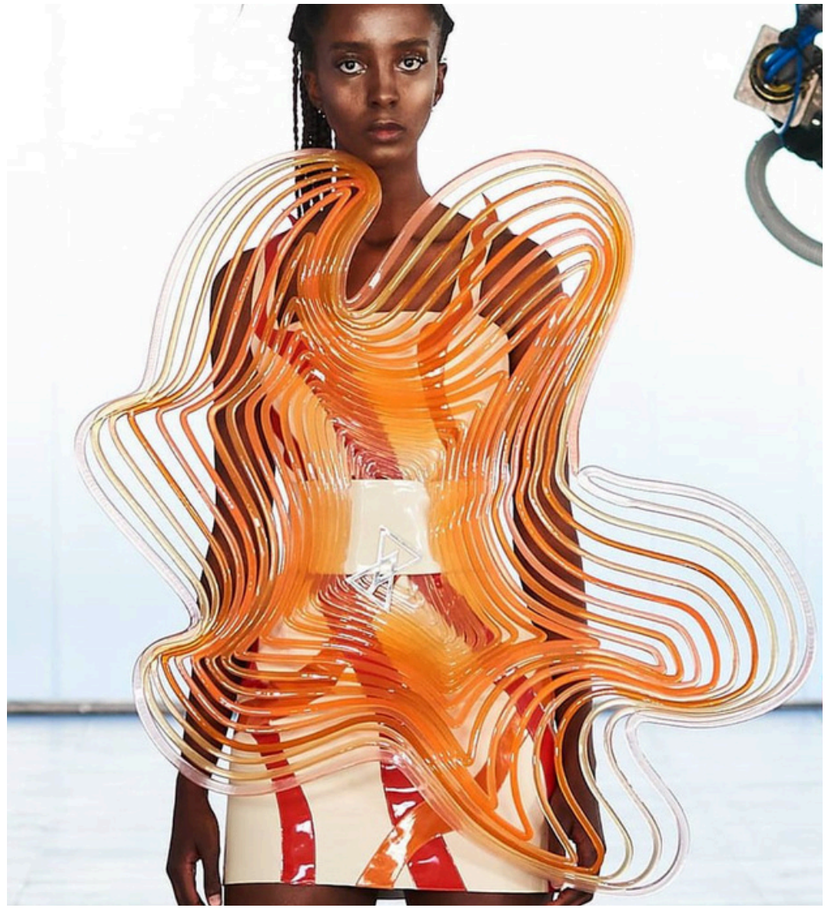
- Chairs
- Table
- Table Lamp
- vases
- Ceiling Lamp
- Item Display

Nagami Design. (n.d.). Innovative design and manufacturing solutions. [online] Available at: https://nagami.design/en/ [Accessed 20 Nov. 2024].

## Potential Applications

### Fashion Industry

- Hand Bags
- 3D Organic Garment Structure
- Upper Part Shoe



Nagami Design. (n.d.). Innovative design and manufacturing solutions. [online] Available at: https://nagami.design/en/ [Accessed 20 Nov. 2024].

## Potential Applications

### Architecture Industry

- Wall Facades
- Ceiling Sheets

Nagami Design. (n.d.). Innovative design and manufacturing solutions. [online] Available at: https://nagami.design/en/ [Accessed 20 Nov. 2024].

## Researching

The project develops an automated robotic manufacturing system that integrates shredding and extrusion processes to transform recycled plastic bottles into intricate designs for applications in furniture, fashion, architecture, and facades.

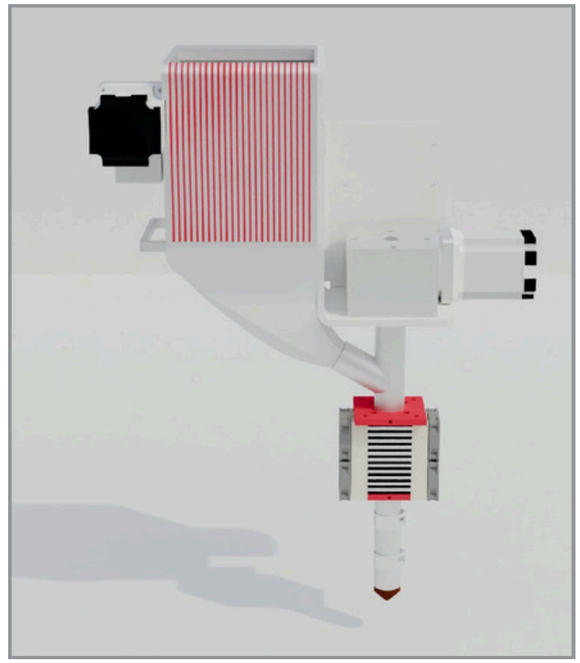
The primary focus of this project is to develop a six-axis robotic manufacturing system that integrates shredding and extrusion processes to transform recycled PET bottles into intricately designed products, such as furniture, fashion and architectural facades. This fully automated system is designed as a versatile installation, adaptable to various events through strategic partnerships across different industries, thereby promoting sustainability and innovation in manufacturing.

## Objectives:

- Develop a compact system combining a robotic arm, shredder, and extruder to efficiently process PET bottles into complex products. Implementing an air-pressure pipeline to ensure continuous and smooth feeding of plastic bottles into the shredding mechanism.
- Enable real-time extrusion of shredded plastic flakes into intricate designs, facilitating immediate product fabrication.
- Demonstrate the viability of recycling plastic waste into valuable products, highlighting sustainable manufacturing practices.

## key Inspirations:

- **Environmental Impact of Plastic Waste:** The pervasive issue of plastic pollution significantly harms ecosystems and human health, necessitating innovative recycling solutions.
- **Enhancing Existing PET Recycling Methods:** Building upon current PET bottle recycling and shredding processes, we aim to develop an integrated, single-unit system that efficiently transforms recycled PET into intricate products, thereby advancing sustainability and manufacturing innovation.
- **Interactive Recycling Experience:** Inspired by installations like Caracol and NYXO's "Portable Heron AM" at Dubai Design Week 2024, which showcased live 3D printing of benches using a robotic arm, we envision an interactive setup where individuals can deposit plastic bottles into the system, witnessing their transformation into intricate designs. This approach fosters direct public engagement in recycling processes, enhancing awareness and participation.



## Design Decisions

To address these challenges and achieve our objectives, several design choices were made:

## Material selection

We selected Polyethylene Terephthalate (PET) due to its prevalent use in the UAE and worldwide, particularly in beverage bottles. By recycling PET into intricate designs across various industries, we aim to reduce environmental impact and promote sustainability while transforming discarded bottles into valuable products, thereby raising awareness about recycling.

## Necessity of the Robotic arm

The end effector is equipped with an air-pressure system that efficiently channels PET bottles into the shredder. Subsequently, the shredded flakes are melted using heat controllers and band heaters, ensuring consistent and controlled melting of the PET material. The molten plastic is then extruded to form new products, streamlining the recycling process into a cohesive operation.

## End effector

Our system is designed as an interactive installation, enabling partnerships with brands across various industries to engage audiences in real-time recycling experiences. The six-axis robotic arm is crucial for executing complex maneuvers within this setup. It precisely handles PET bottles, positions them for shredding, and directs the extrusion nozzle during product formation. This automation reduces human error and processing time, ensuring accurate alignment and manipulation. As a result, the produced items exhibit enhanced robustness and structural integrity compared to traditional manual methods.

## Vendors

**Robotic Components:**

- **KUKA 6-Axis Robotic Arm:** Provides precise and flexible automation capabilities essential for complex recycling processes.
- **Servo Motors (2x MG 995):** Offer accurate control for specific mechanical movements within the system.
- **Stepper Motors (2x NEMA 11):** Enable precise positioning and speed control for various system components.

**Software Tools:**

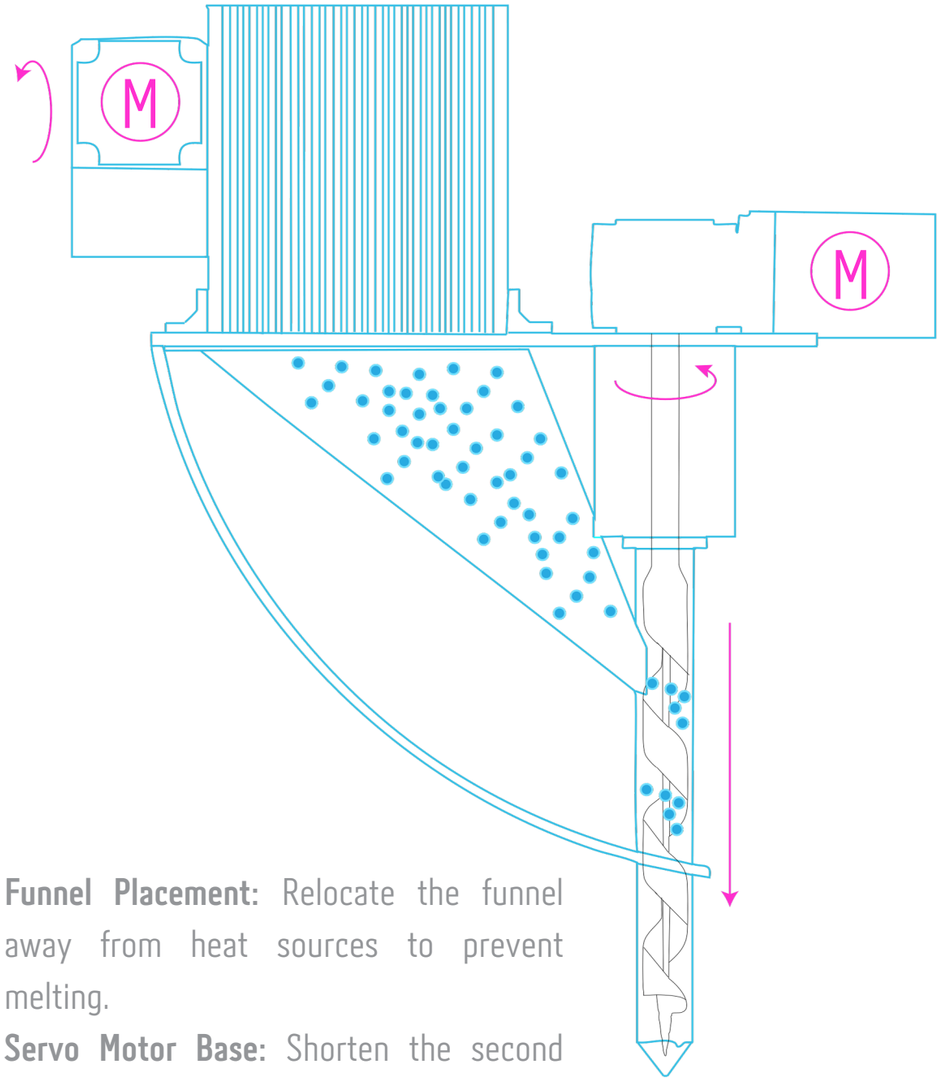
- **Fusion 360**: Utilized for comprehensive 3D modeling and design of system components.
- **Servo Motor Control Interface:** Web-based platform for programming and managing servo motor operations.

**Prototyping and Fabrication Services:**

- **In5 FabLab:** Located in Dubai, offering facilities for laser cutting and 3D printing, instrumental in developing prototypes and custom parts.
- **Laser Craft Industry:** Specialized in fabricating metal components, including shredder blades, metal sheets, attachments, and heating layers.
- **Ras Al Khor Industrial Area:** Sourced pipes and the auger from local shops to integrate into the recycling system.

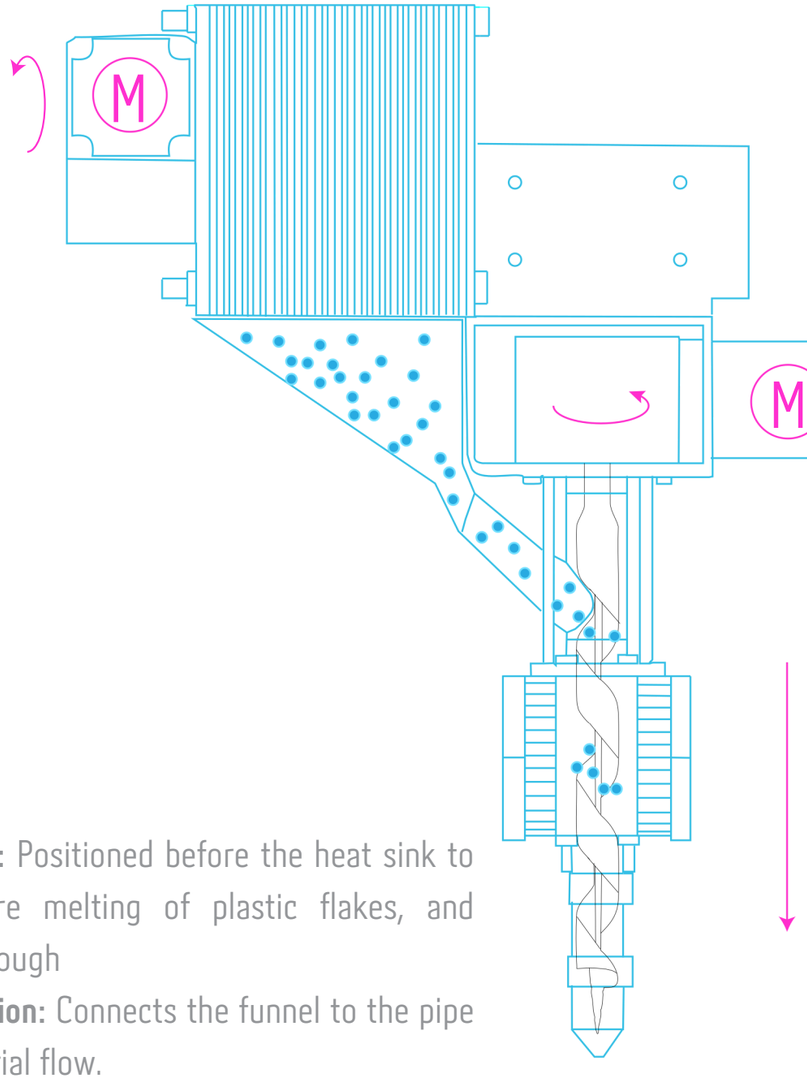
## Iterations

### First Iteration




- **Funnel Placement:** Relocate the funnel away from heat sources to prevent melting.
- **Servo Motor Base:** Shorten the second servo motor's base to eliminate unnecessary length.
- **System Holder:** Redesign the holder to enhance overall stability.

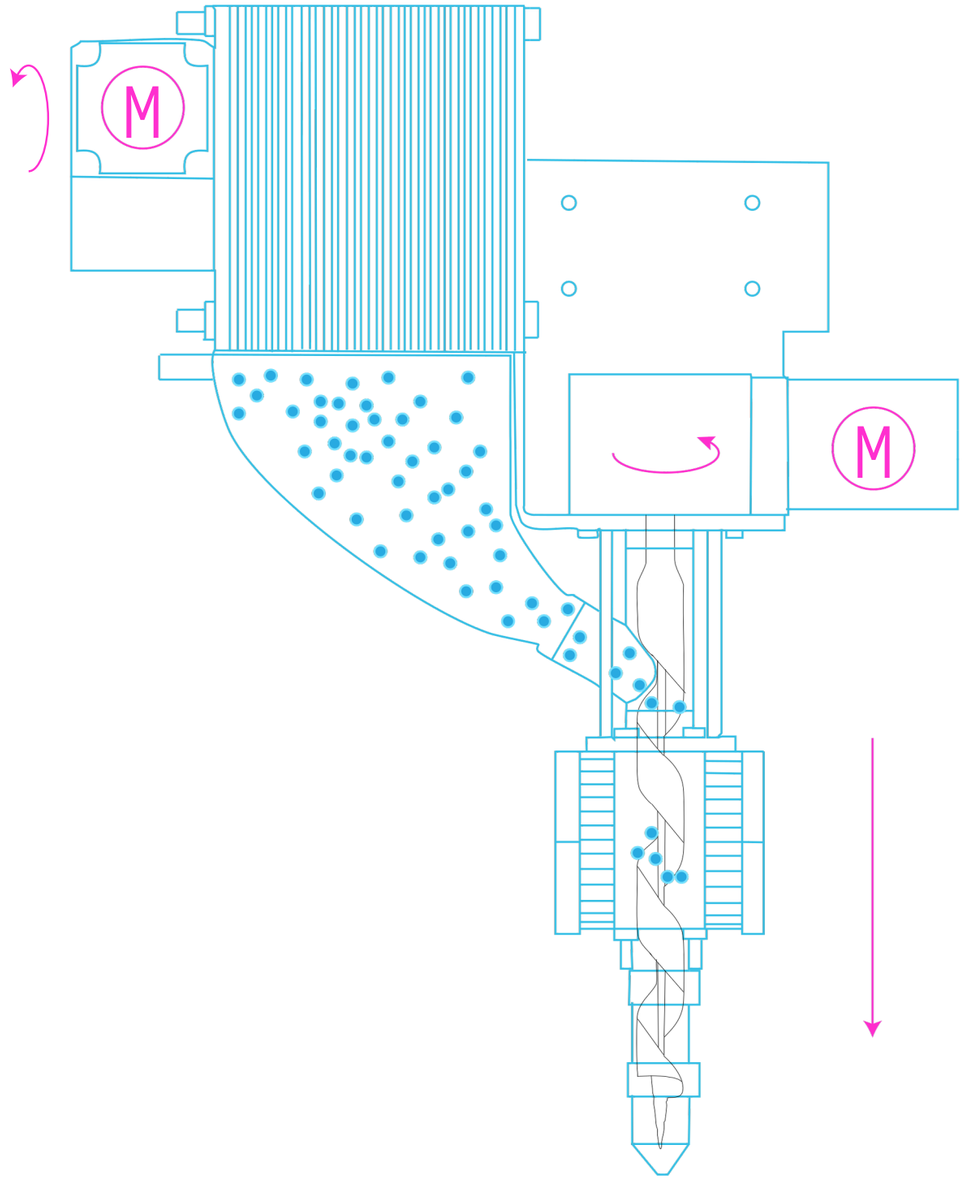
### Second Iteration



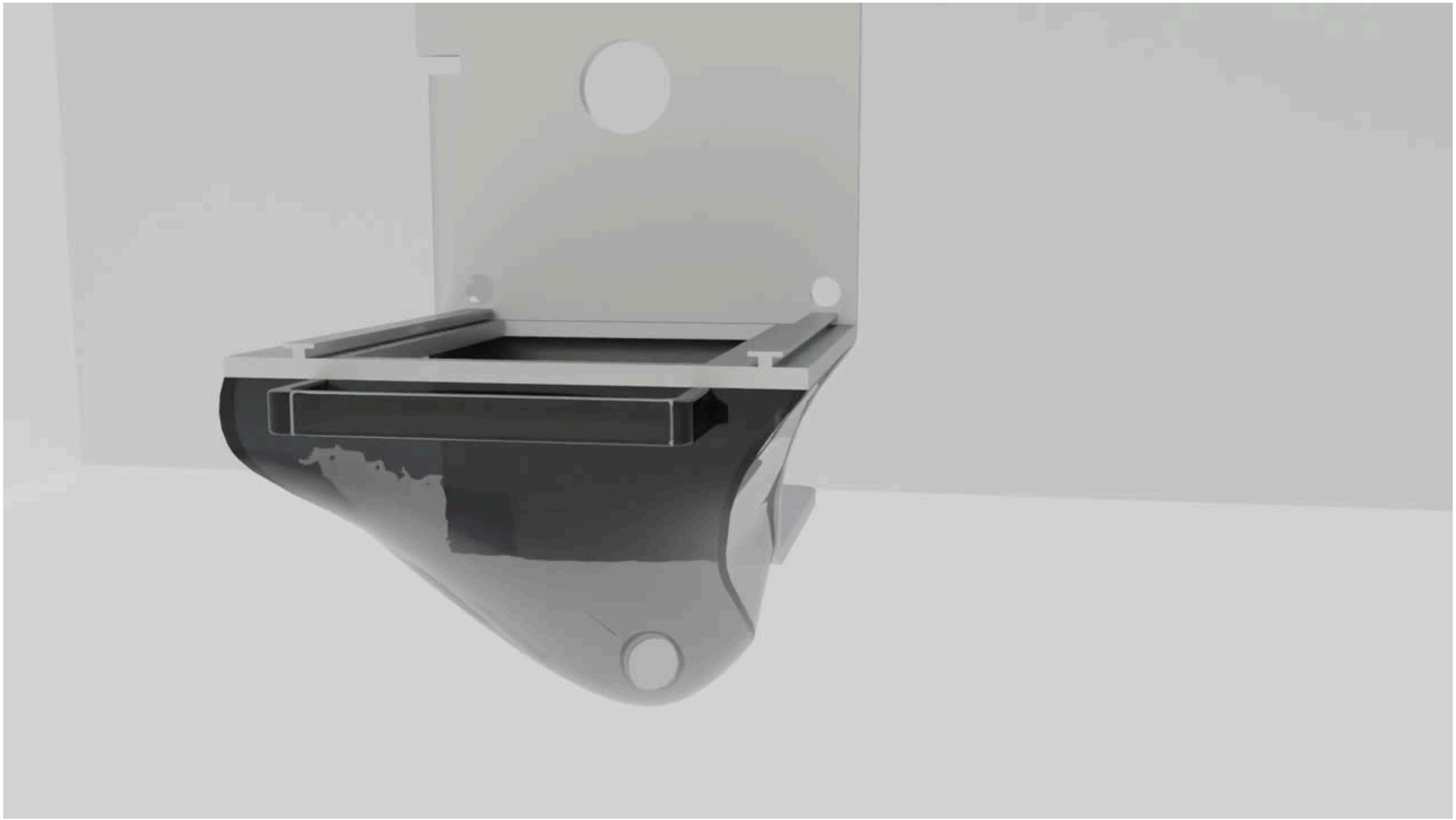

- **Funnel Placement:** Positioned before the heat sink to prevent premature melting of plastic flakes, and wasn't smooth enough
- **Intake Tube Addition:** Connects the funnel to the pipe for efficient material flow.
- **Servo Motor Positioning:** Mounted at the funnel's base to streamline operations.
- **Cooling System Integration:** Equipped with fans and heat sink layers to ensure effective cooling.

## Final Iteration

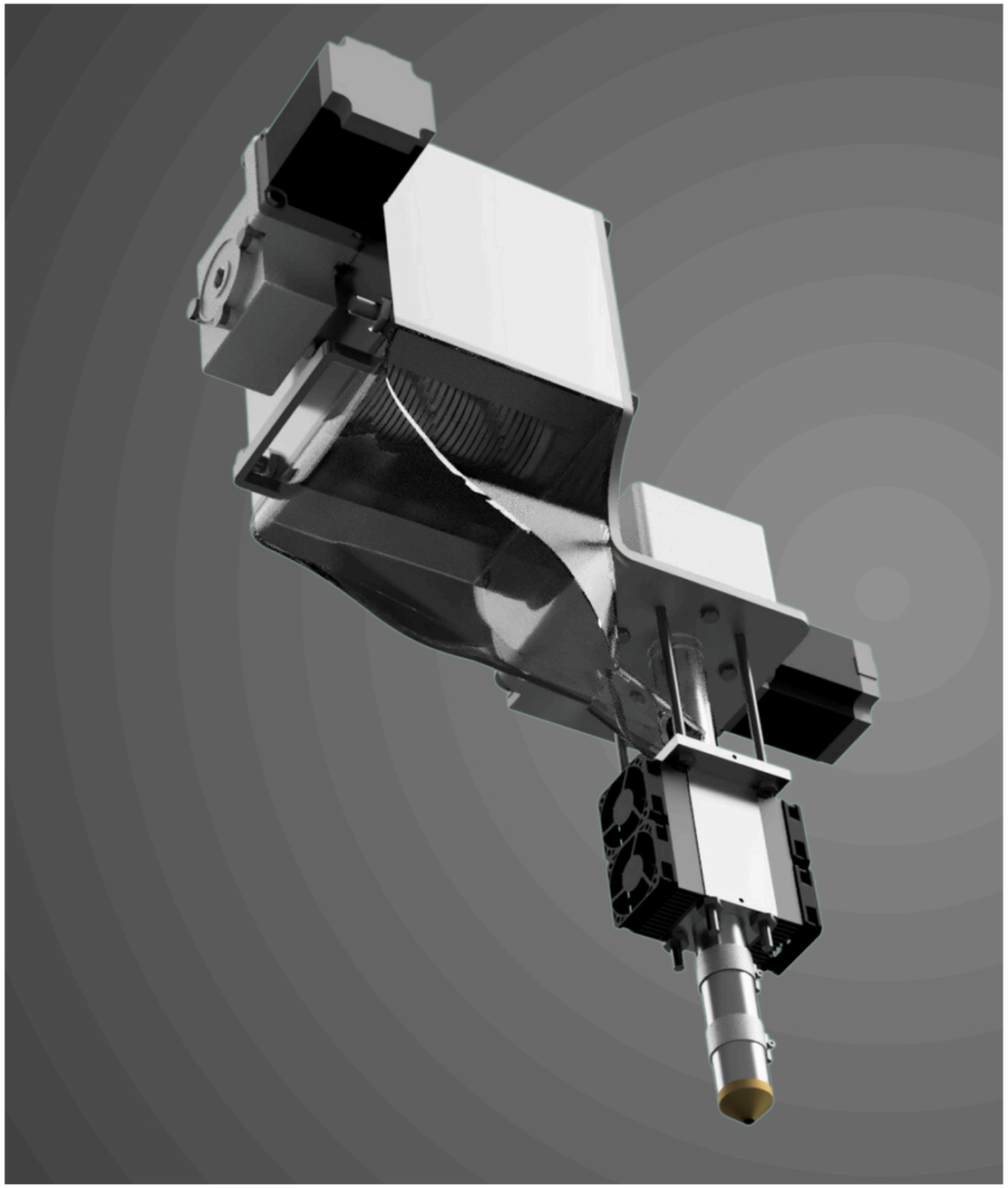
- **Funnel Design:** Smoothed and curved the funnel to facilitate efficient transfer of shredded plastic into the intake tube.
- **Base Redesign:** Rounded the system's base to eliminate sharp edges, enhancing safety and aesthetics.
- **Funnel Handle Addition:** Attached a handle to the funnel to simplify the removal of residual plastic flakes during cleaning.
- **Heat Band Placement:** Positioned heat bands after the heat sink to ensure proper heating during extrusion.

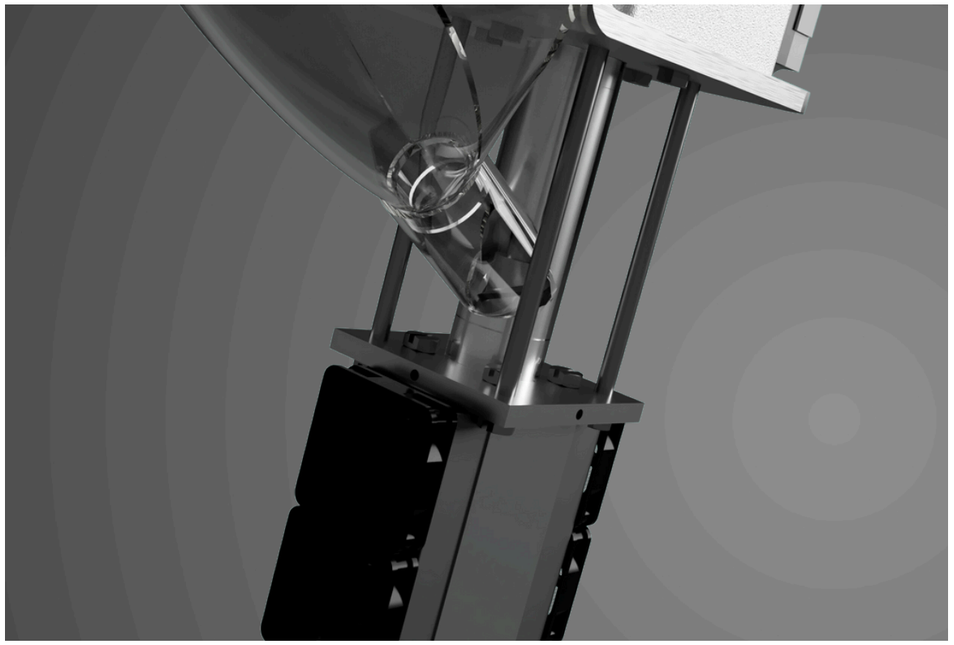


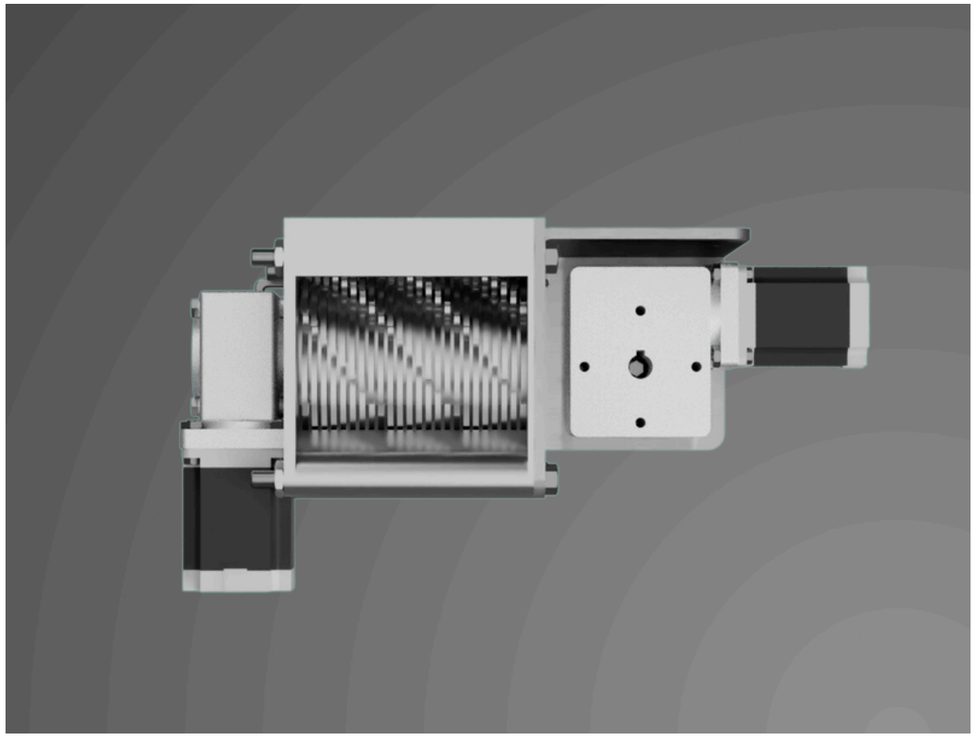
# Replastify Assembly Animation

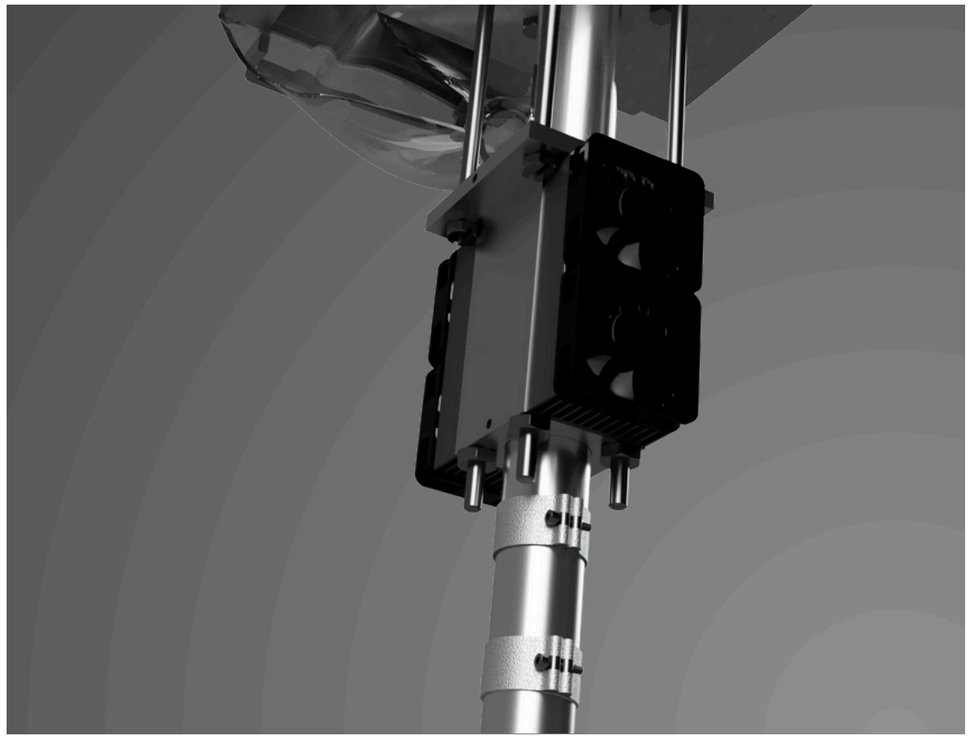


# 3D Model

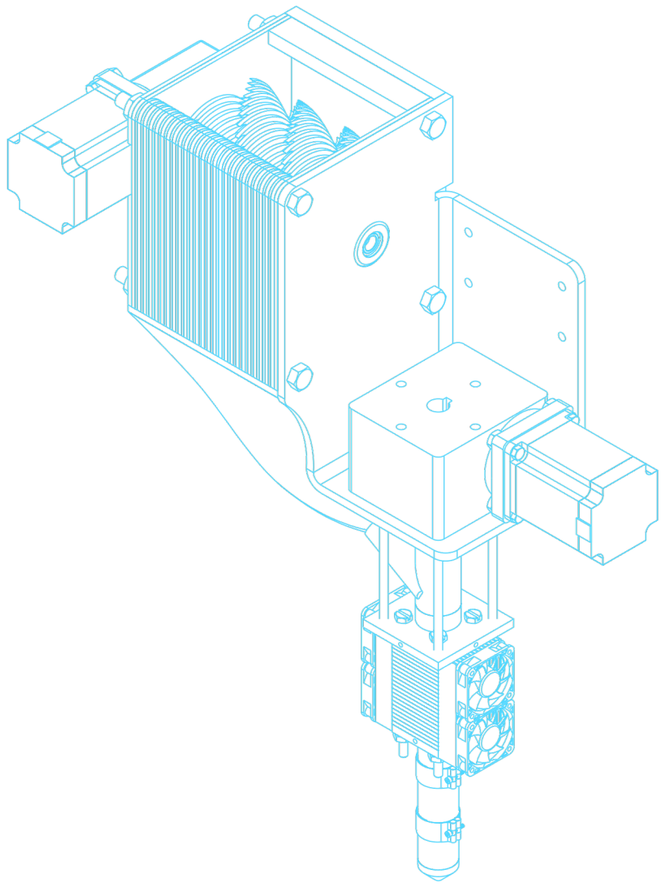




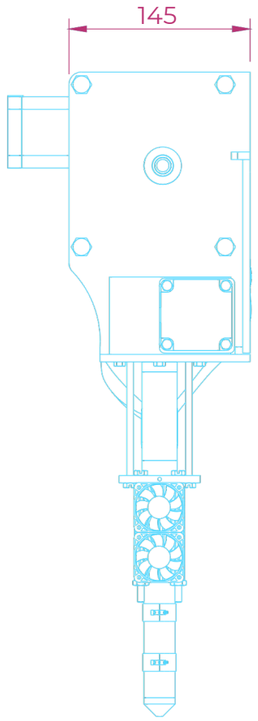




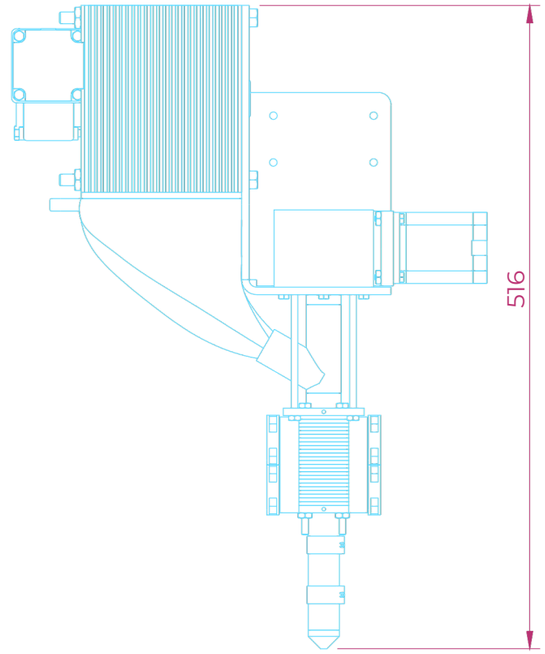
# Technical Drawings / Orthogonal Views



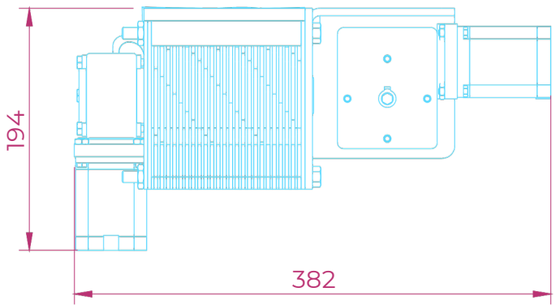
Perspective View




Side View

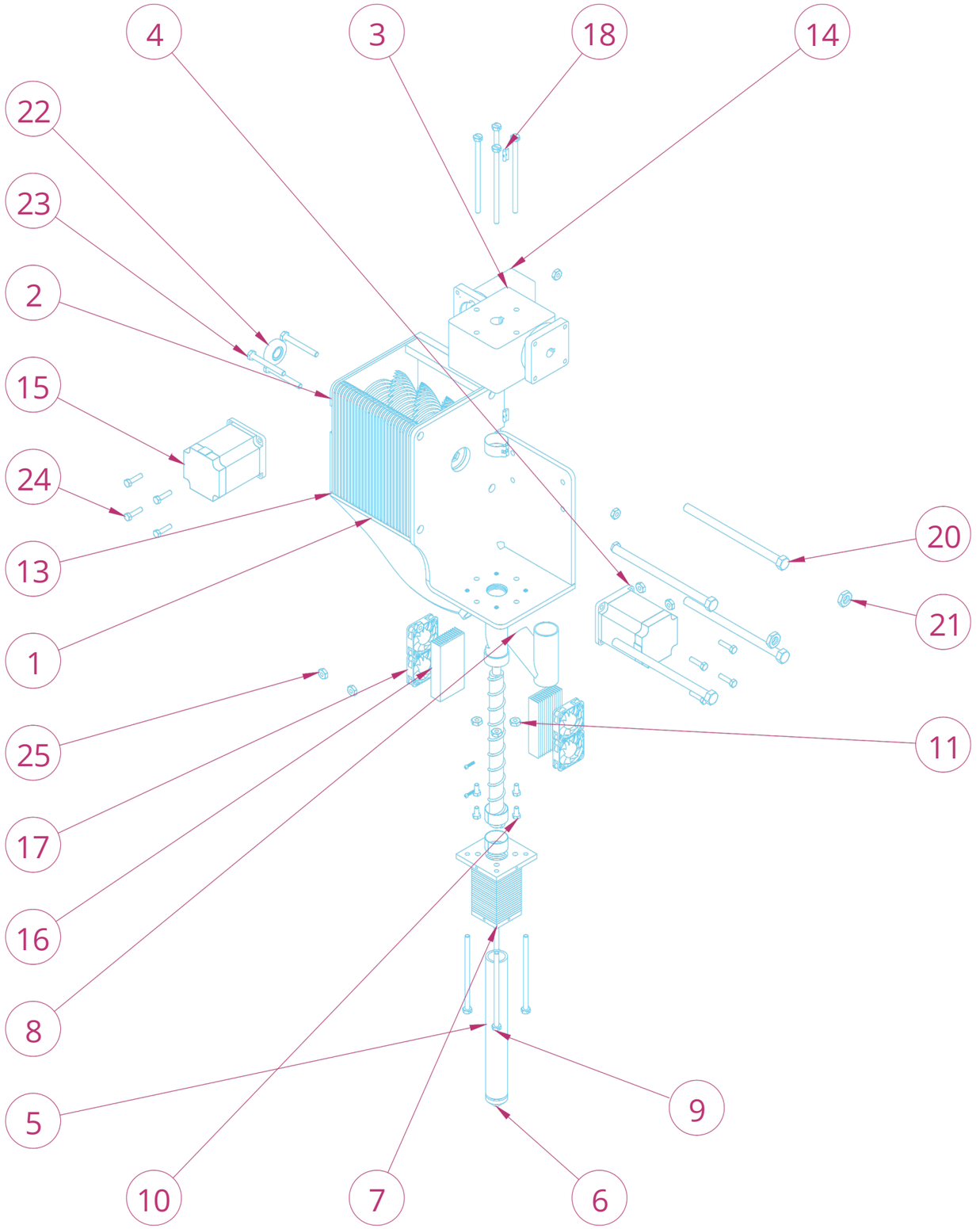



Front View



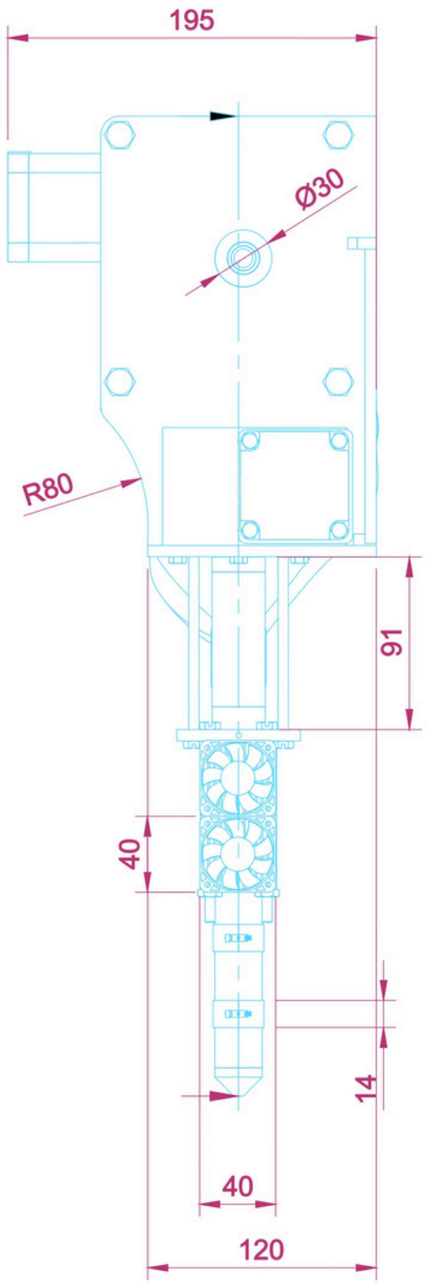

Top View

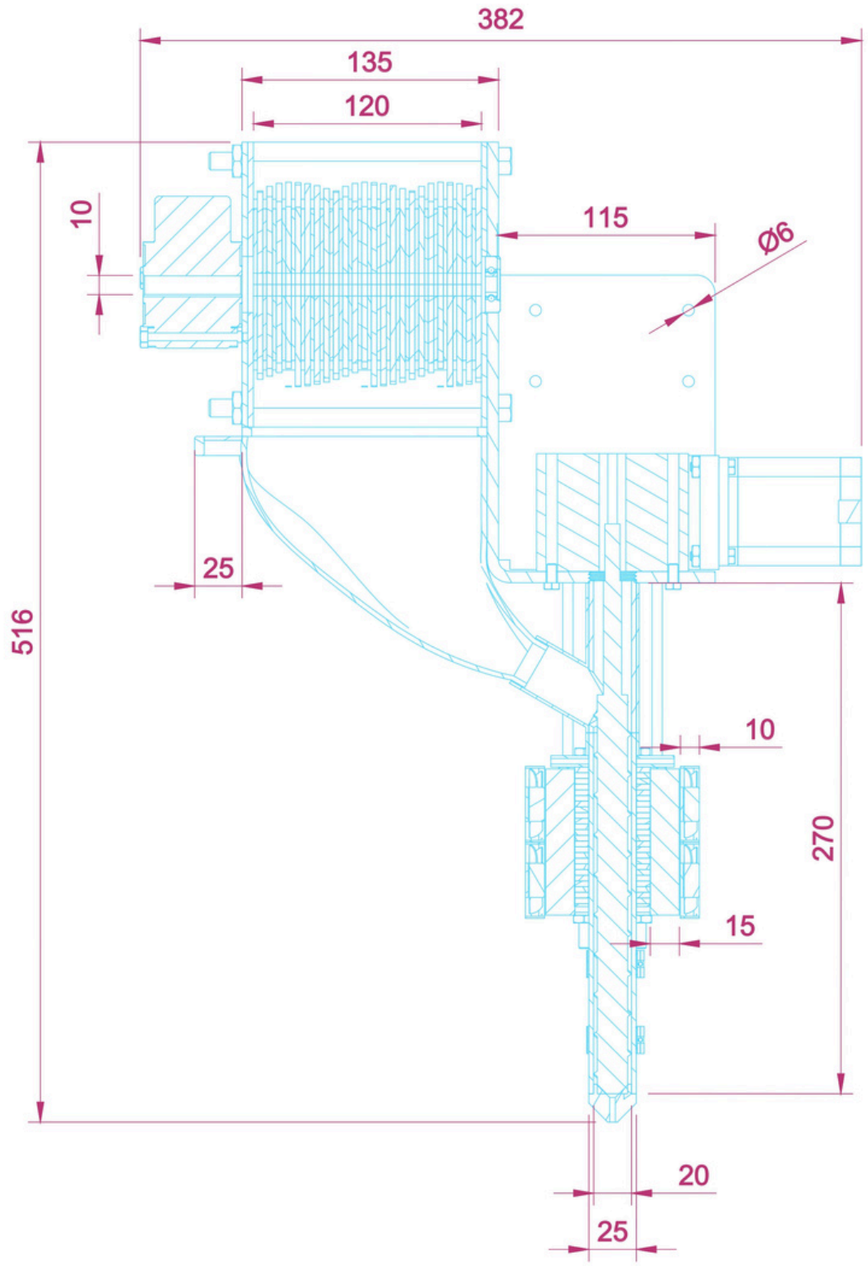
# Technical Drawings / Exploded View




| Item | Part Number | Material |
|---|---|---|
| 1 | Main body | Steel |
| 2 | Shredder | Steel |
| 3 | Big gear | Steel |
| 4 | motor | Steel |
| 5 | Pipe | Steel |
| 6 | nozzle | Steel |
| 7 | heatsink cube | Steel |
| 8 | Auger feeder | Steel |
| 9 | heatsink cube bolt | Steel Grade 2, Plain |
| 10 | big gear bolt | Steel 4.6, Plain |
| 11 | nutsz | Steel Grade 2H, Plain |
| 12 | Document | Steel |
| 13 | funnel | Steel |
| 14 | small gear | Steel |
| 15 | Motor | Steel |
| 16 | Heatsink | Steel |
| 17 | 40mmFan | Plastic, Opaque White |
| 18 | BandHeater | Steel |
| 19 | Bottle pipe | Steel |
| 20 | shredder | Steel Grade 2, Plain |
| 21 | Shredder nut | Steel 6, Plain |
| 22 | MG-A3187 | Steel |
| 23 | gear screw | Steel 4.6, Plain |
| 24 | motor screw | Steel |
| 25 | nut | Steel Grade 2H, Plain |

# Technical Drawings / section



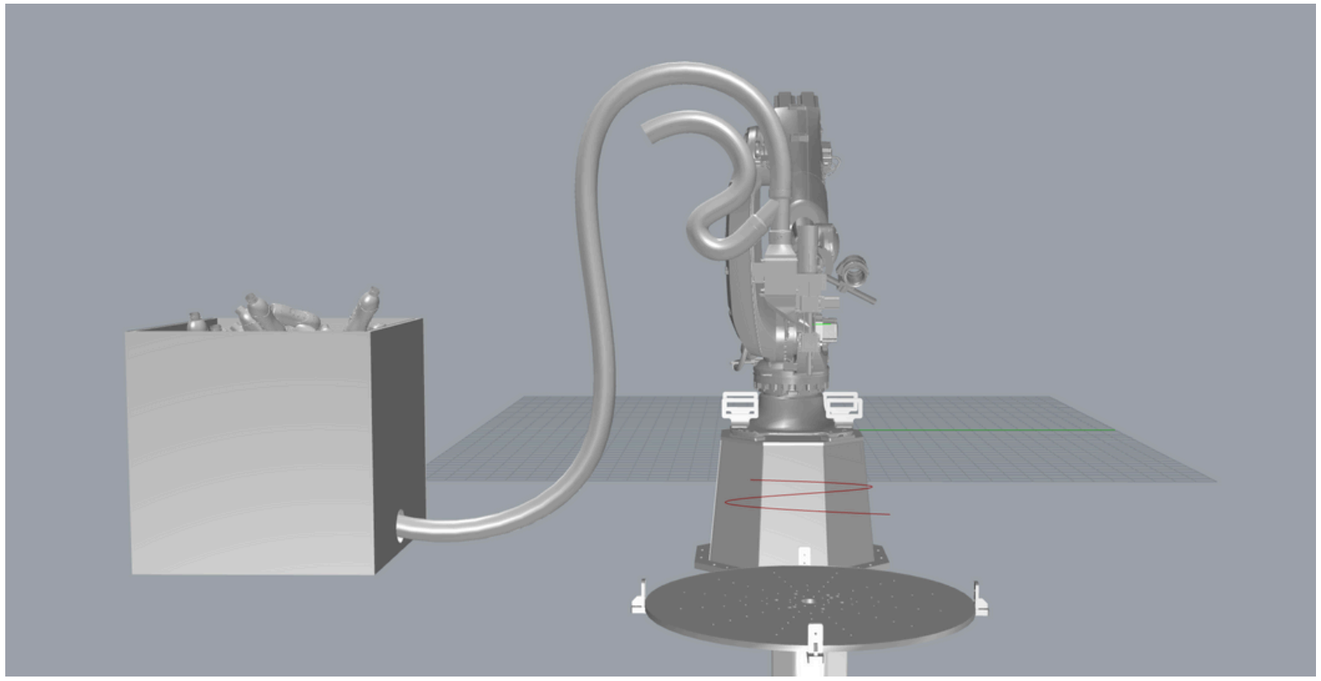



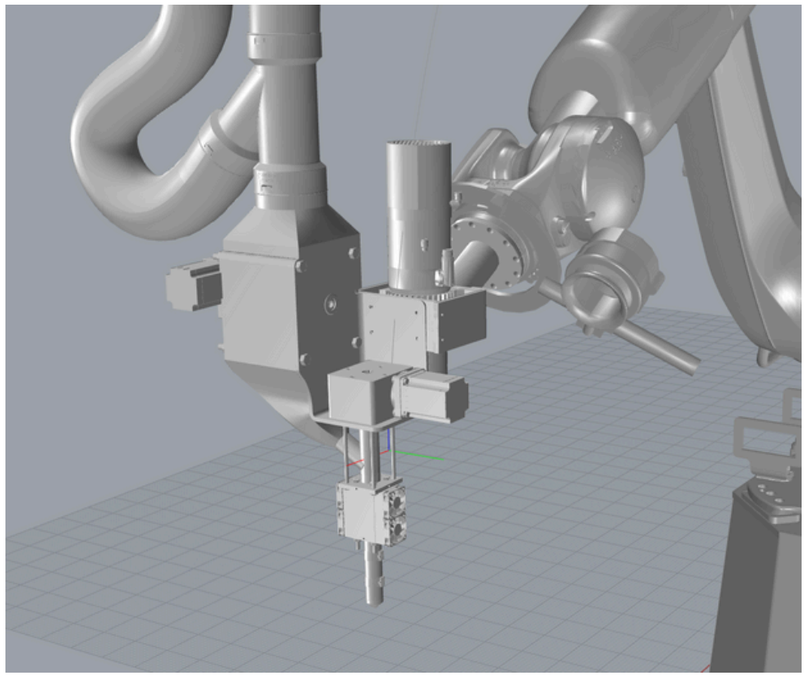
## Replastify System 3D Model

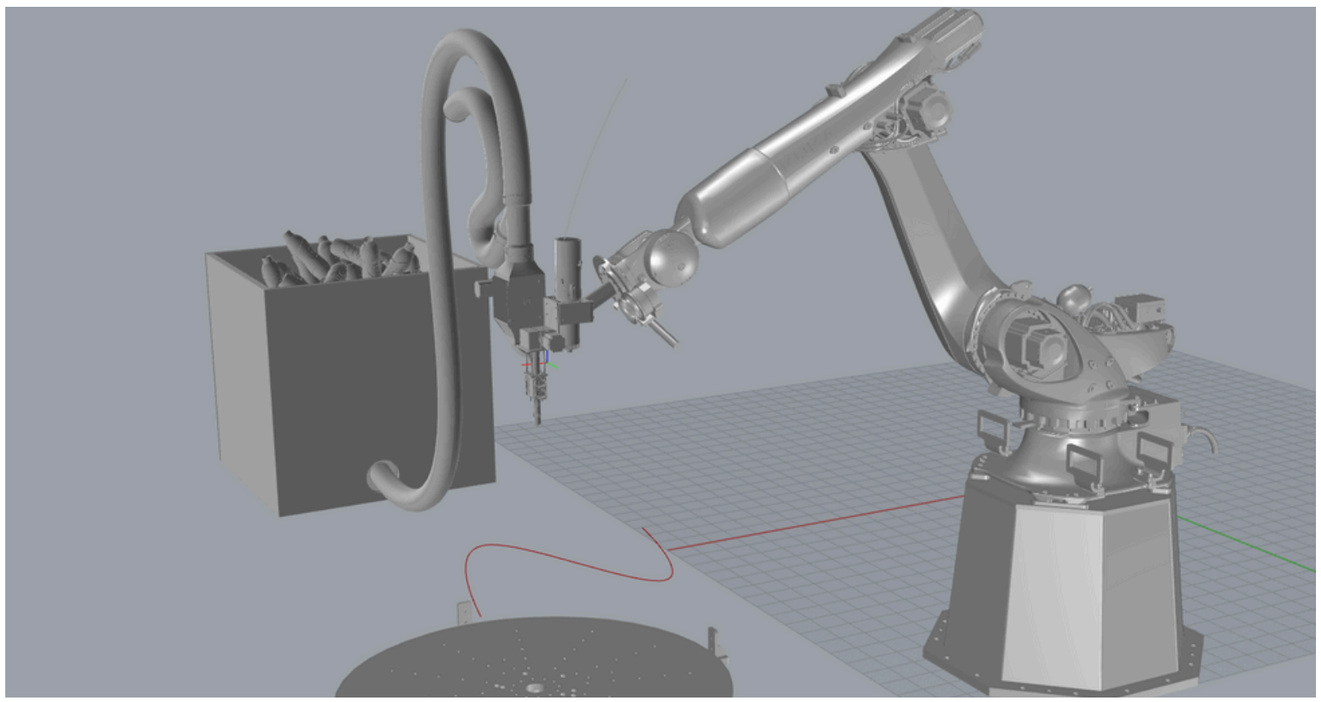
## Air – Pressure Pipeline

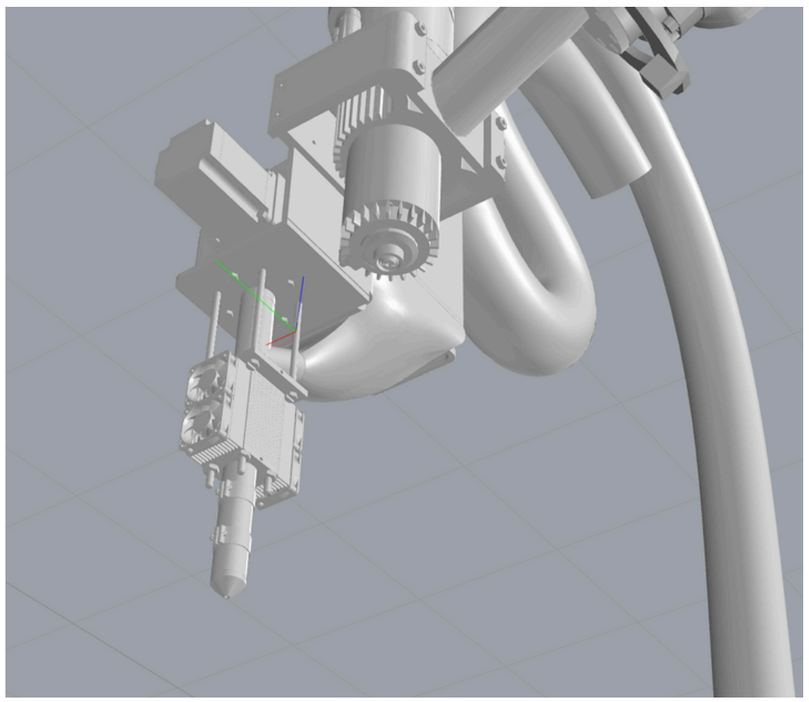
- **Compact Design**: Combines a robotic arm, shredder, and extruder into a single, efficient unit.
- **Continuous Feeding:** PET plastic bottles are fed through an air-pressure pipeline for smooth, uninterrupted movement into the shredder.

# ROBOT Attachment





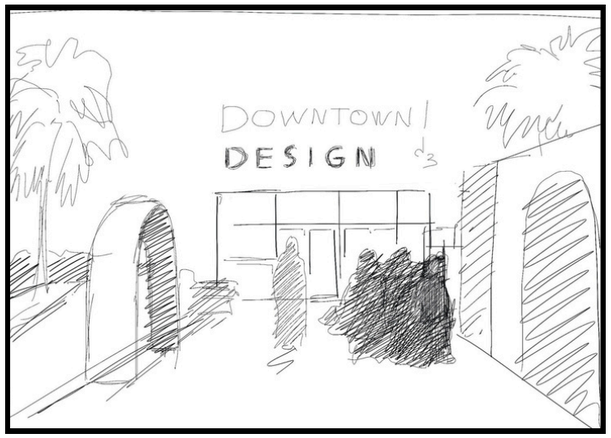


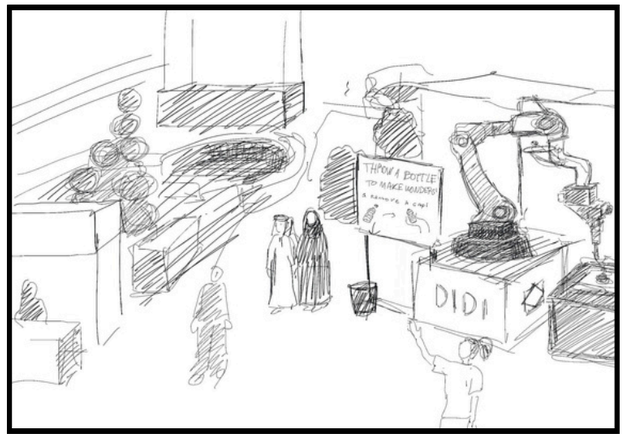


# How Replastify Works?


THROW A BOTTLE
TO MAKE WONDERS

# StoryBoard



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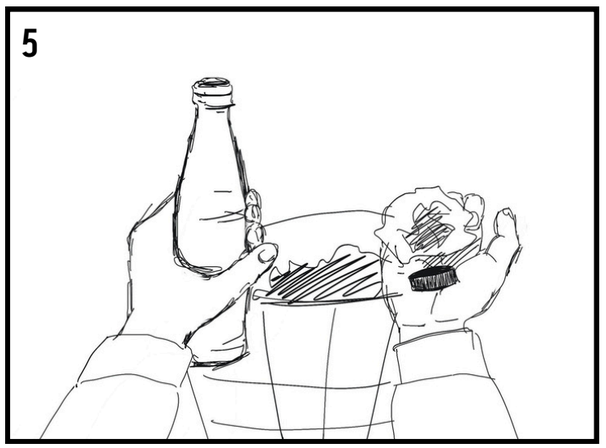

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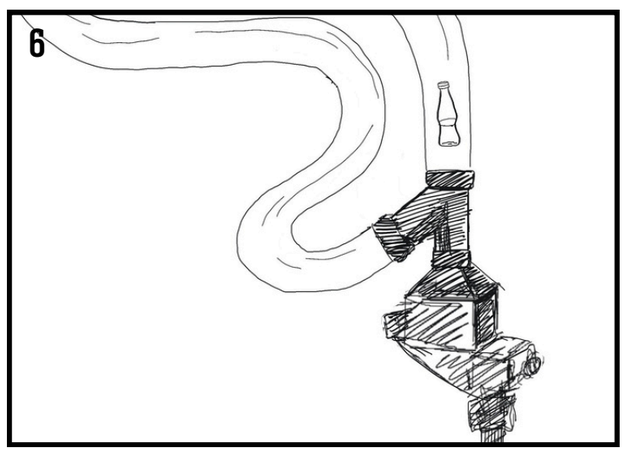

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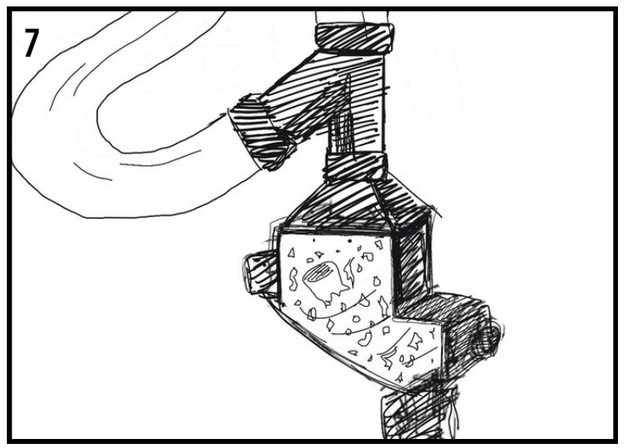

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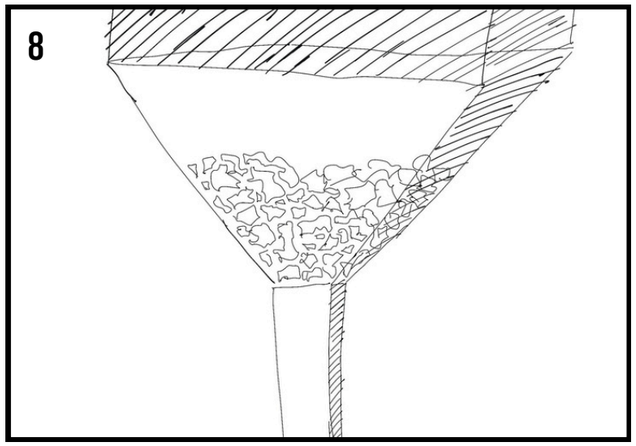

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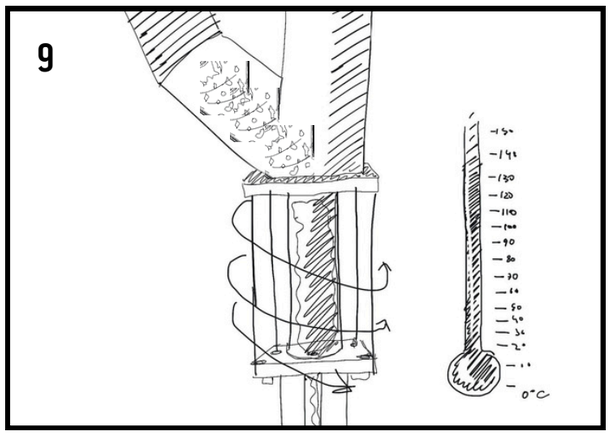

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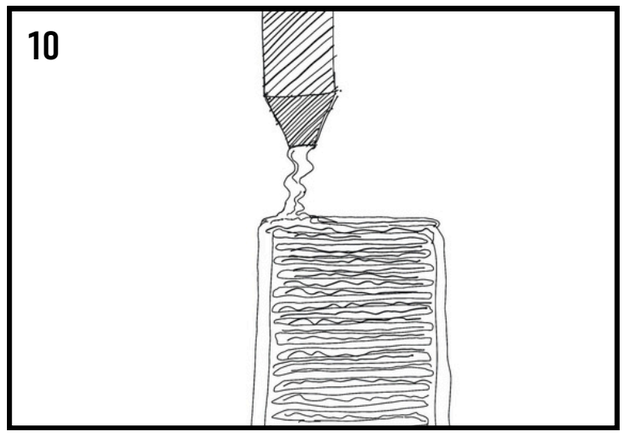

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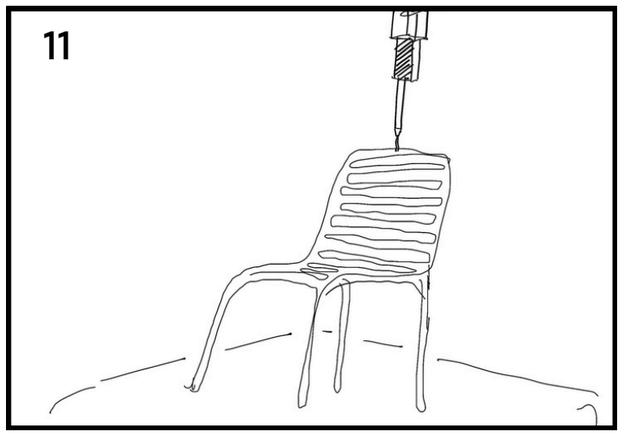

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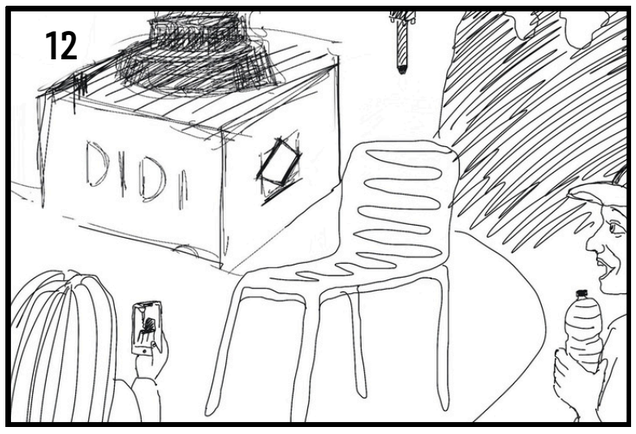

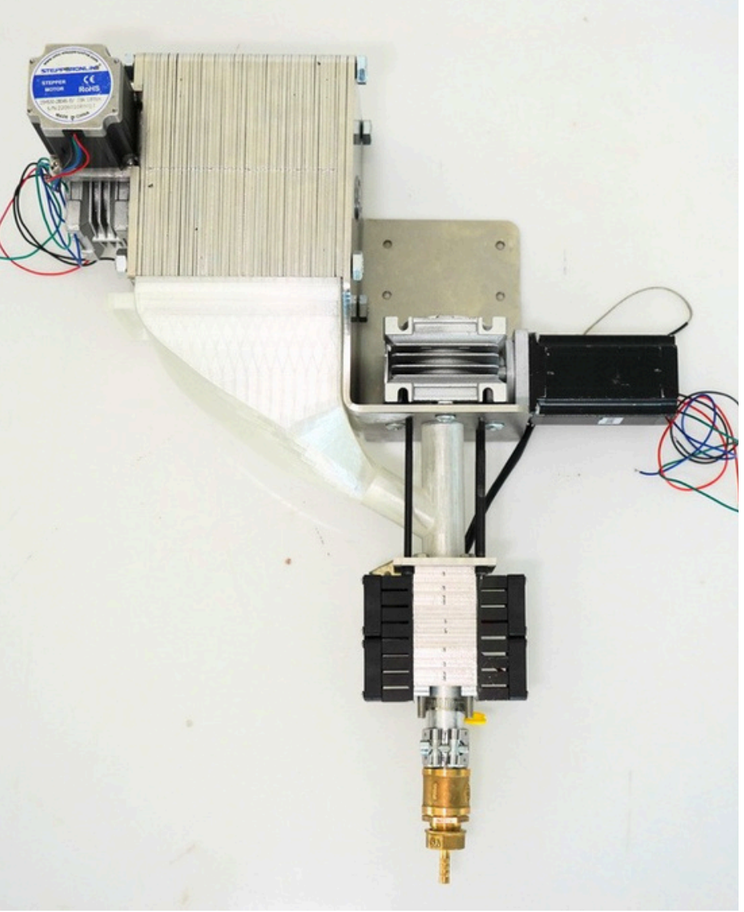

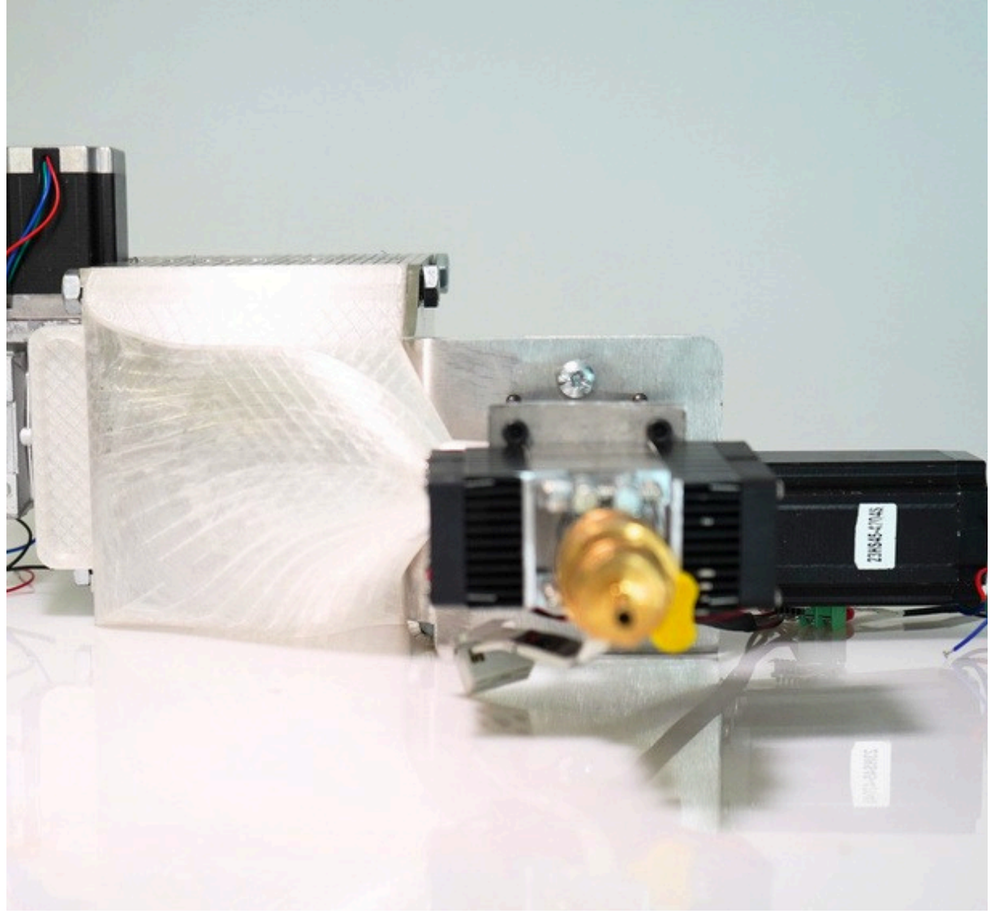

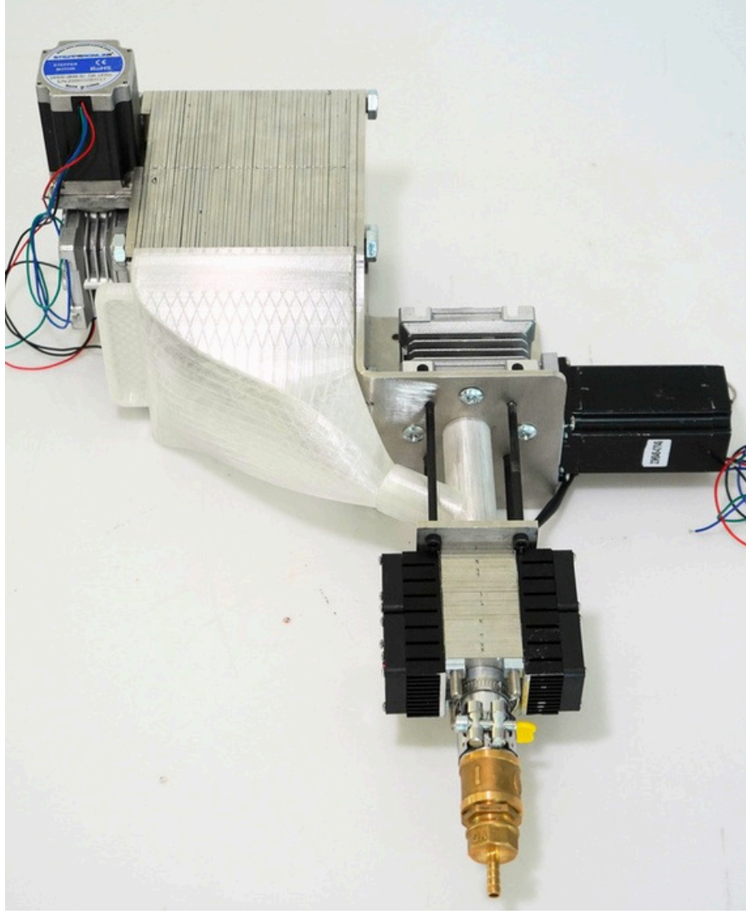

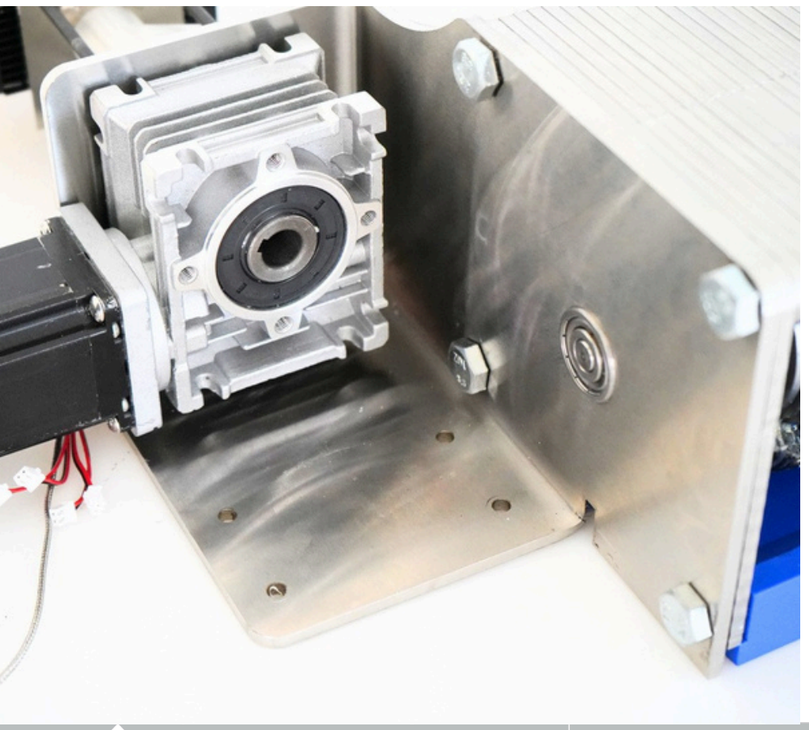

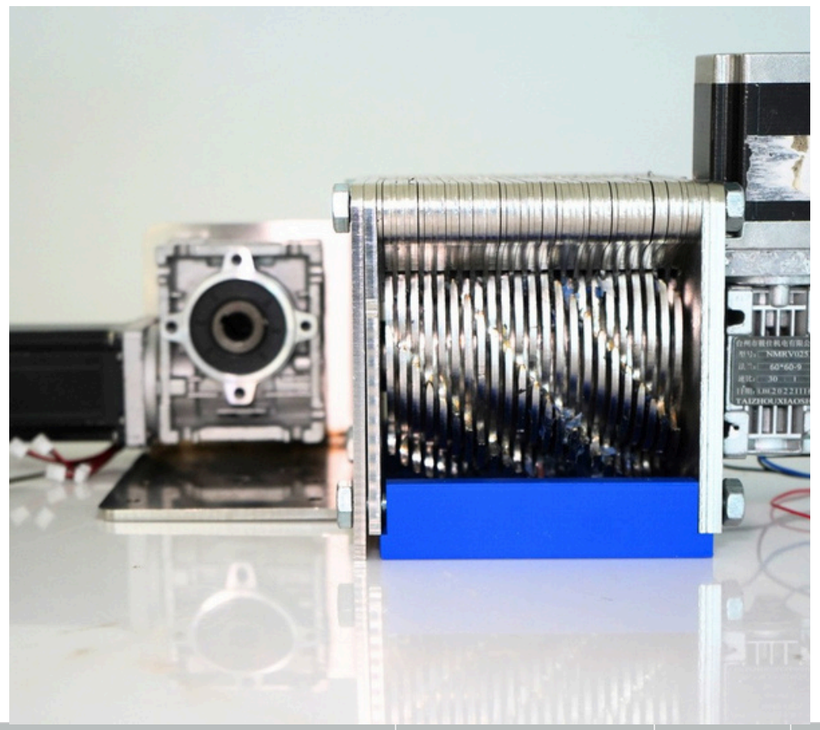

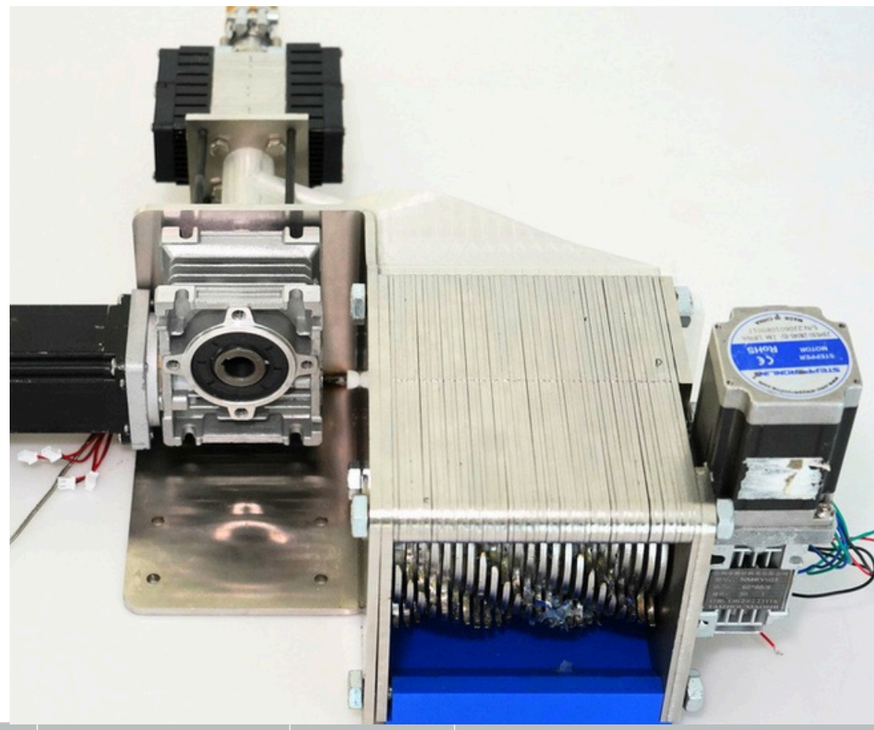

# The End

**Jeeda Sabbagh | Aya Al Atrash | Abdullah Kojak**

Documentation_30.10.24

## POTENTIAL TARGET

1. Elderly People (55+)
2. People of Determination (People with Disabilities)
3. Adults for mixed genders (20-55)
4. Students

## ELDERLY PEOPLE (55+)

**Needs:**

1. Ease of Use: Products that are easy to grip, open, and handle to accommodate diminished strength and dexterity.
2. Safety and Comfort: Non-slip surfaces, shatter-resistant materials, and ergonomic designs to prevent accidents.
3. Health and Wellness: Products that support their health, such as pill organizers or assistive devices, which promote independence.

**Pains:**

- Difficulty with Complex Designs: Complicated interfaces or instructions lead to frustration and reluctance to use new products.
- Safety Concerns: Risk of injury from using breakable or non-stable products, particularly in home environments.

**Persona**: Elderly customers seek simplicity, durability, and functionality in products that enhance independence, safety, and wellness without compromising on ease of use. A PET plastic product for this group could be lightweight, easy to grip, and safe for daily use.

## PEOPLE OF DETERMINATION (PEOPLE WITH DISABILITIES)

**Needs:**

1. Accessibility: Adaptable, customizable designs that cater to a wide range of disabilities (physical, visual, auditory, cognitive).
2. Independence: Tools that promote self-sufficiency, such as easy-to-use containers or assistive equipment.
3. Durability and Lightweight: Sturdy yet portable products that are not too heavy, facilitating easier mobility and daily use.

**Pains:**

1. Limited Functionality of Generic Products: Many traditional products lack accessibility features, making them hard or impossible to use independently.
2. Safety Risks: High risk of injury from unstable or fragile items; needs reliable, sturdy, and user-friendly designs.
3. Unintuitive Designs: Complex designs that don't accommodate their physical needs can lead to dependency on others, reducing autonomy.
4. Cost of Specialized Products: Accessible products are often more expensive, limiting options within affordable ranges.

**Persona**: Individuals with disabilities look for practical, accessible products that facilitate independence and offer safety without high cost. A PET-based product, such as an easy-open, shatterproof, adaptable storage container, would meet these needs by combining durability, simplicity, and user-friendliness.

# PEOPLE OF DETERMINATION (PEOPLE WITH DISABILITIES)

## Adaptive Orthotic Devices:

Challenge: Current orthotic devices are often rigid, expensive, and not tailored to gradual changes in disability needs.

mpact: Increased accessibility to quality orthotics at a lower price point, with the added benefit of adaptation over time, reducing waste and costs.

## Flexible Bath Safety Bars

Challenge: Fixed safety bars in bathrooms are often inconvenient and do not account for different user heights or grip preferences.
Improvement: Develop 3D-printed PET safety bars with flexible joints, allowing users to adjust angles or lengths to fit their needs. PET's resistance to moisture makes it ideal for wet environments.

## PEOPLE OF DETERMINATION (PEOPLE WITH DISABILITIES)

1. Adaptive Water Bottles – Durable, easy-to-grip bottles with a twistable top that is accessible for users with limited hand strength. PET plastic makes them lightweight, shatterproof, and easy to clean, which is helpful for those with reduced dexterity.
2. Ergonomic Cutlery Handles – Utensils with PET plastic handles shaped for a secure grip, providing a practical solution for users with hand mobility issues while maintaining durability.
3.
4.

## ADULTS FOR MIXED GENDERS (20-55)

**Needs:**

1. Multi-functionality: Busy lifestyles call for versatile products that can be used across various settings (e.g., home, work, outdoors).
2. Design and Style: Aesthetic appeal is important, especially for products carried around or displayed; simple, modern designs with customization options are popular.
3. Convenience: Easily portable, compact products that support an on-the-go lifestyle and are convenient to clean, store, and use.

**Pains:**

- Limited Time: Products that require minimal maintenance and effort to use are valued by those balancing work and personal lives.
- High Expectations for Durability: Fragile or short-lived products are often viewed as wasteful, pushing consumers toward durable, long-lasting options.

- **Persona**: Adults aged 20-55 look for eco-friendly, stylish, multi-functional products that suit their active, eco-conscious lifestyles. A PET plastic reusable bottle or multi-compartment food container with an attractive, minimalist design would appeal to this demographic by addressing their sustainability goals and convenience needs.

## STUDENTS

**Needs:**

1. Affordability: Budget-friendly products that can be reused and have long-term value, essential for students managing limited finances.
2. Durability: Strong products that can withstand daily handling, especially in school or campus environments.
3. Portability: Lightweight and easy-to-carry items that fit into backpacks or lockers for on-the-go convenience.

**Pains**:

- Budget Constraints: Limited budgets mean students prioritize affordable, high-quality products that provide lasting value.

**Persona**: Students are eco-conscious, budget-minded, and value durability and portability in products. A PET plastic water bottle or lunch container with a secure lid and stackable design would be ideal, providing both environmental value and practical, daily utility.

## WHY?

1. reduce cost
2. reduce time (quick use)
3. Increased Efficiency and Streamlined Workflow
4. Continuous, Closed-Loop Recycling Process: By integrating the shredder and extruder directly onto the robotic arm, the PET material can move seamlessly from shredding to extrusion.

## CHALLENGES OF USING A SEPARATE SHREDDER FOR PET RECYCLING

- **Increased Handling and Transfer Requirements:**Using a separate shredder requires additional handling and transfer steps to move shredded PET from the shredder to melting and extrusion machines. This extra handling can lead to material loss, increased labor, and potential contamination from dust or other materials during transport (Yousef et al., 2019).
- **Higher Energy Consumption:**Separate shredding machines increase energy consumption since they need to be operated independently from the melting and extrusion machines. This makes the entire recycling process more energy-intensive, particularly if the shredding machine has to be operated at specific speeds or power levels for PET (Rahimi & Garcia, 2017).
- **Additional Maintenance and Operational Costs:**A separate shredder requires its own maintenance, lubrication, and potentially different adjustments for shredding PET effectively. This increases operational costs, particularly if the shredder experiences wear and tear from handling hard or thick PET items, which can blunt blades and require frequent servicing (Awasthi et al., 2017).
- **Potential for Increased PET Degradation:**PET can degrade with repeated processing stages. If PET remains in a shredded form for an extended period before melting, it can absorb moisture from the air, which leads to hydrolytic degradation during melting, compromising the quality of the recycled PET (Hopewell et al., 2009).

1. Recommended PET-Based, 3D-Printed Products:
2. Interlocking Modular Building Blocks: Lightweight, durable, and easy to assemble, ideal for non-load-bearing walls in residential or commercial spaces.
3. Insulation Panels: Energy-efficient panels that meet UAE's green building codes, offering thermal resistance suited to the climate.
4. Decorative and Acoustic Wall Panels: Customizable designs that appeal to high-end interiors for aesthetic and noise reduction.
5. Flooring Tiles: Slip-resistant, weatherproof tiles for outdoor and indoor use in residential or hospitality projects.
6. Roof Shingles: UV-resistant, lightweight shingles designed for the UAE's hot climate, easy to install and maintain.
7.

1. Interlocking Modular Blocks
Use: For quick, efficient assembly of partition walls, decorative facades, and temporary structures.
Benefits: Lightweight, durable, and easy to assemble without adhesives. Ideal for rapid construction and reusable in multiple projects.
Investor Appeal: Modular blocks reduce labor and material costs, offer flexibility, and are perfect for UAE's growing focus on sustainable, quick-build solutions.
2. Wall Panels (Insulated & Decorative)
Use: Widely used for interior partitions and exterior cladding, with insulated versions helping reduce cooling costs.
Benefits: PET panels are customizable, energy-efficient, and visually appealing—catering to both aesthetic and thermal needs.
Investor Appeal: With the UAE's building regulations favoring energy-efficient designs, these panels present a high-demand, sustainable choice that meets regulatory standards and reduces operational costs.
3. Roofing Tiles
Use: Ideal for roofs in outdoor structures, from residential buildings to temporary constructions.
Benefits: UV-resistant, lightweight, and weatherproof, providing a cost-effective, durable roofing option.
Investor Appeal: Roofing tiles from PET are quick to install, heat-resistant, and sustainable—highly suited to the UAE climate and construction trends.

Here's a concise list of strong investor appeal points:

1. High Demand & Market Alignment: UAE's booming construction industry and government initiatives for sustainable building create strong demand for eco-friendly materials.
2. Sustainability & Circular Economy: The project recycles PET waste into valuable products, appealing to investors focused on ESG metrics and corporate responsibility.
3. Cost Savings & Profitability: PET is cheaper and lighter than traditional materials, reducing costs, while eco-friendly products can command premium prices for higher margins.
4. Scalability & Flexibility: Modular PET blocks, panels, and tiles adapt easily across construction applications, from temporary to permanent structures, allowing broad market appeal.
5. Innovative Technology: The KUKA robotic arm offers cutting-edge, efficient recycling and manufacturing, creating a market differentiator and brand appeal.
6. Long-Term Growth Potential: Sustainable construction is a long-term priority in the UAE, ensuring steady demand and growth potential in a future-proof market.

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