

Mechanical Clock

Section 5

Team 4

Parth, David, Haris

Team Members and Responsibilities

Name	Responsibilities
Haris Bashir	Crank, Minute-Hand, Hour Hand
Parth Vijay	Shafts, Housing
David Baron- Vega	Gears+ Gear Math

Problem Statement

- Our goal is to create a clock which allows for the user to rotate a crank and have the hands move in a manner which is accurate to the ratios of a clock.

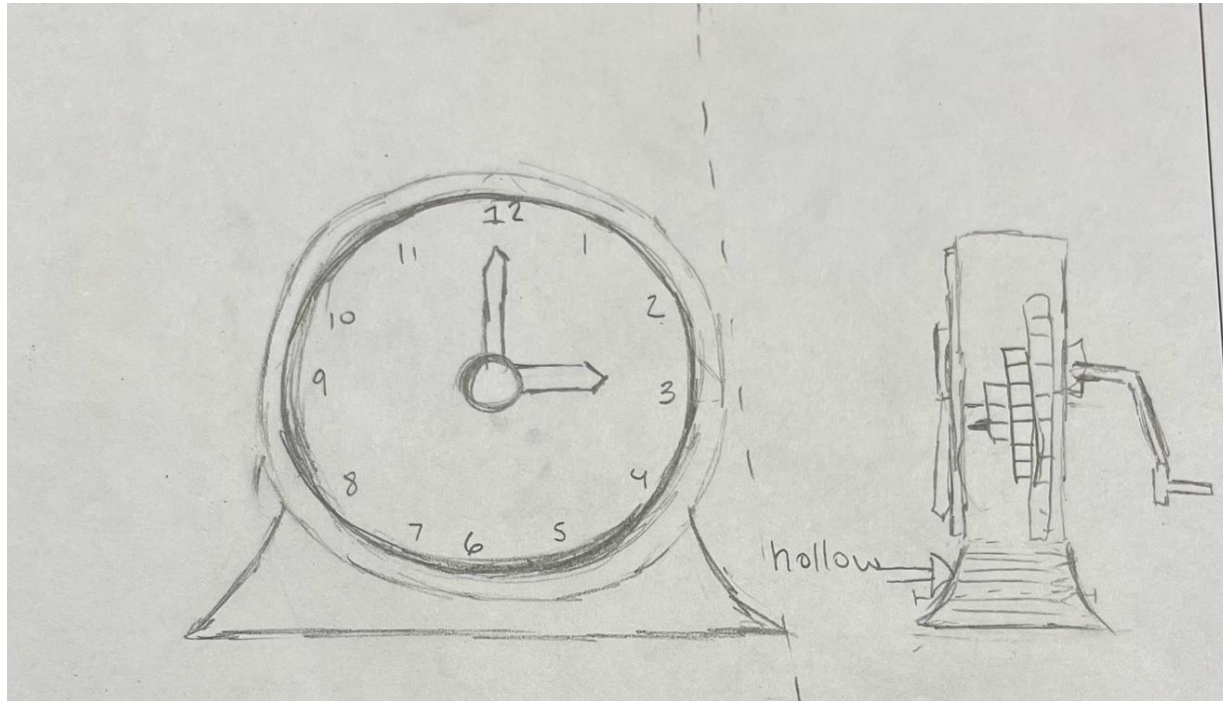
Requirements

User Needs	Design Inputs
Clock should be reasonable size	10 inch diameter
Appropriately spaced notches to tell time	Evenly spaced numbers, proportionally sized hour and minute arms, Different color for arms and rest of clock for visibility.
Clock needs to be durable enough to move and tell time.	Pins and threaded screws/holes should be included for fastening.
Should not use too much material	Print time of all parts combined cannot exceed about 40 hours.

Design Outputs

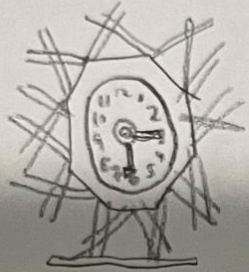
Concepts

Concept 1



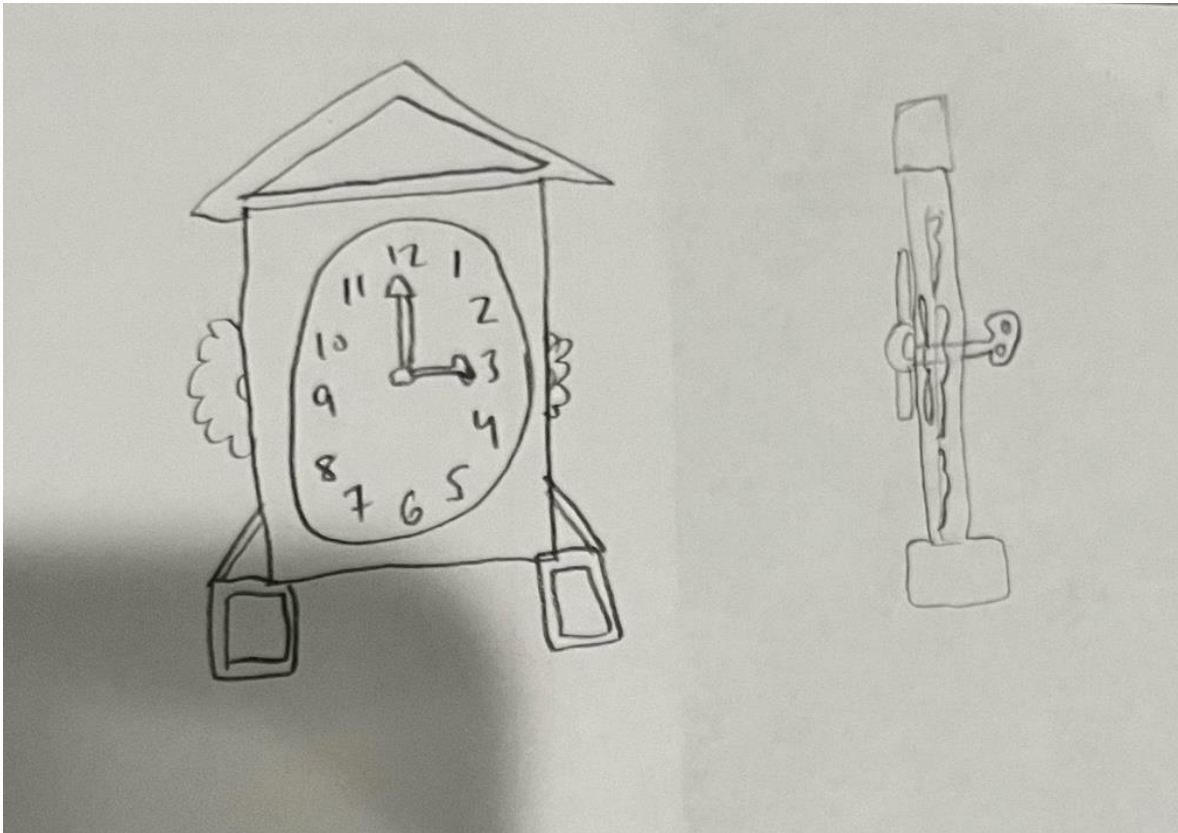
- This model of a clock is pretty standard along with a base for support

Concept 2



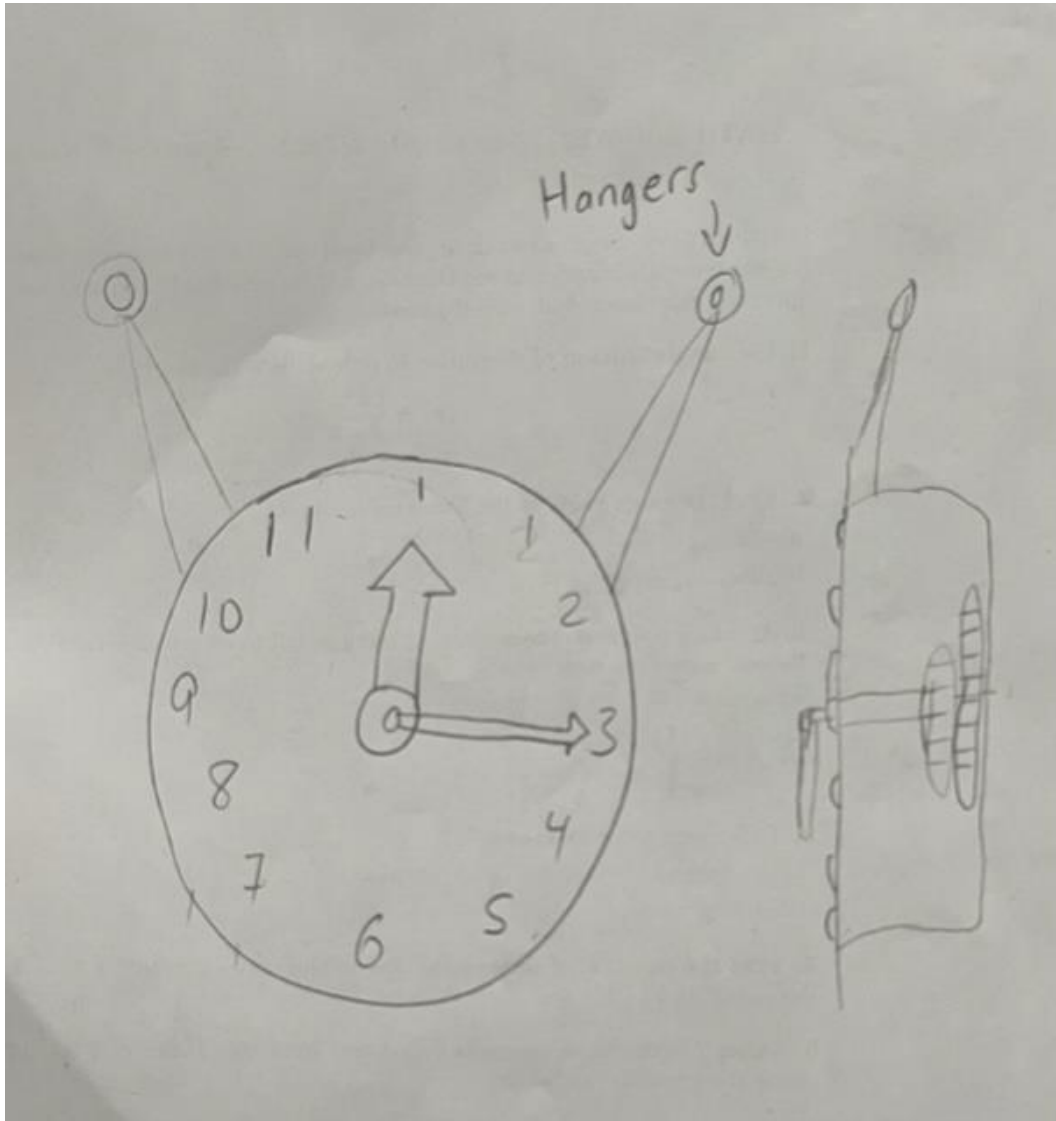
- This model of a clock would use long thin printed strips to form a “geometric” design on the body

Concept 3



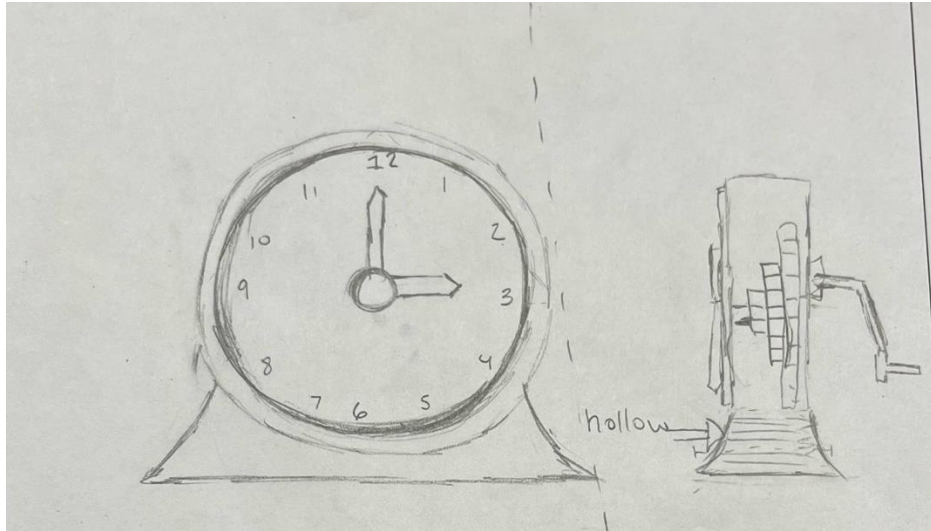
- This version of a clock resembles a mini grandfather clock and has gears coming outside the clock

Concept 4



- It is a hanging clock with two arms that can be used to hang the clock. There was a hollow side with the gears inside and right beside each other. This was a fairly large sized clock.

Selected Concept



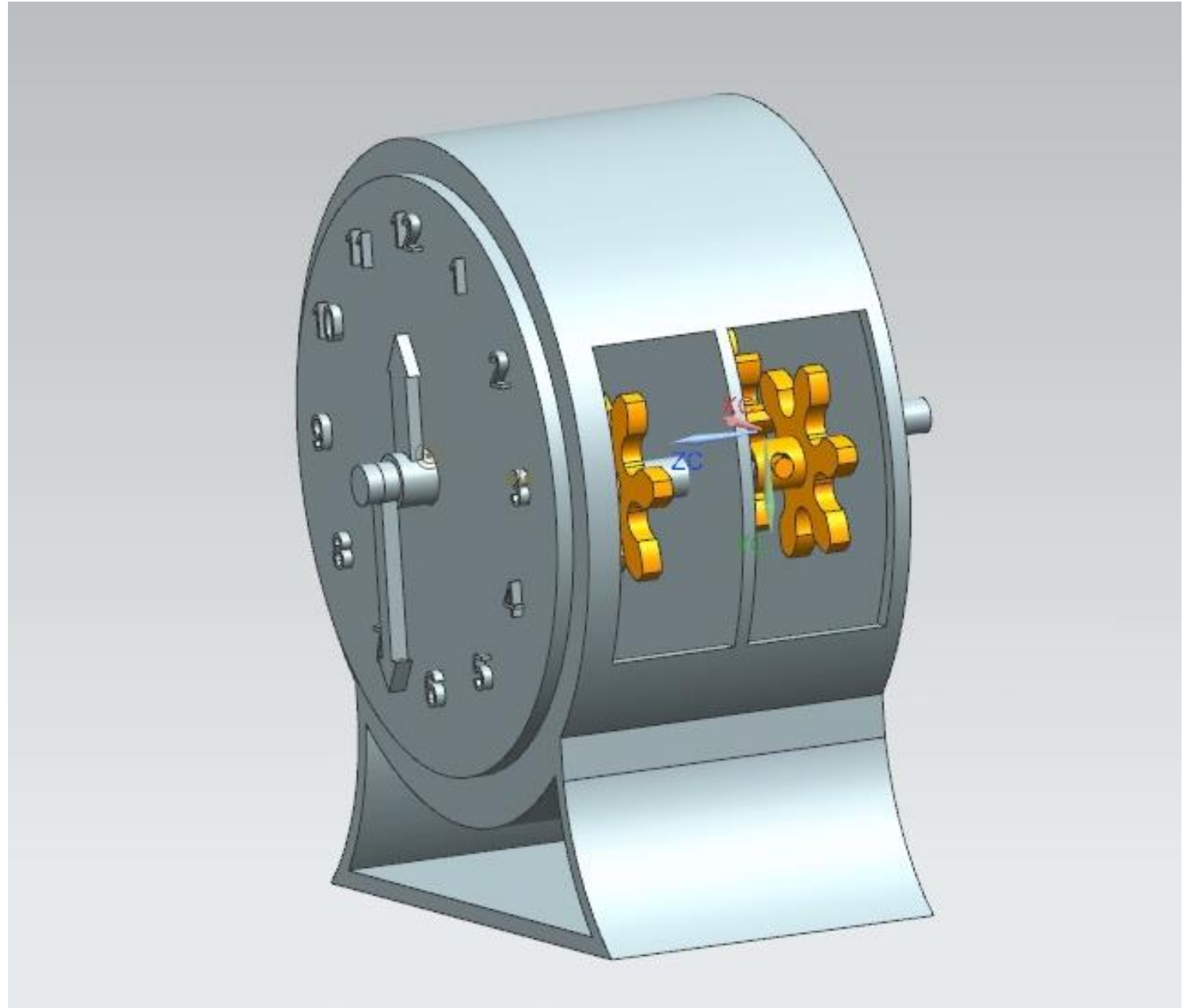
- We chose this version due to its simple and versatile design as well as the material saved from having a hollow base. The open sides allowed for space for the gears and we could add two shafts that would move independently.

Design Outputs

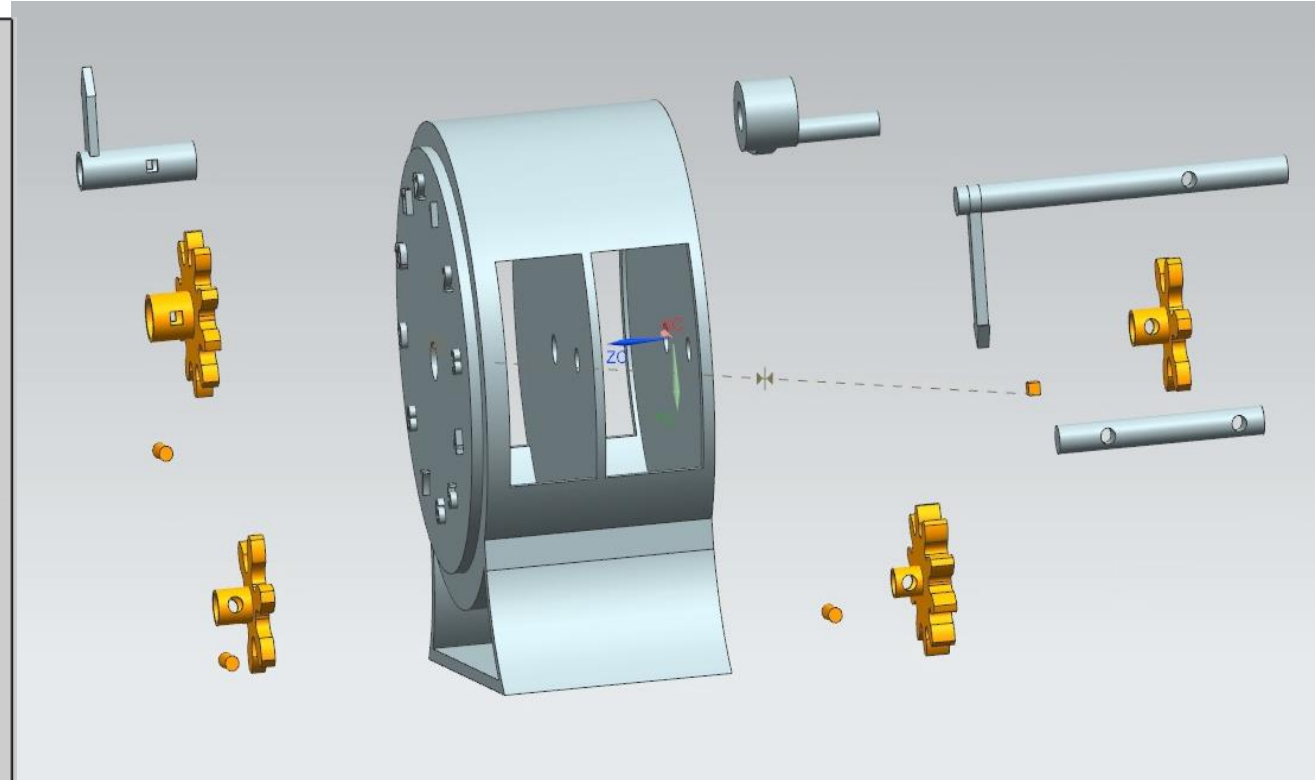
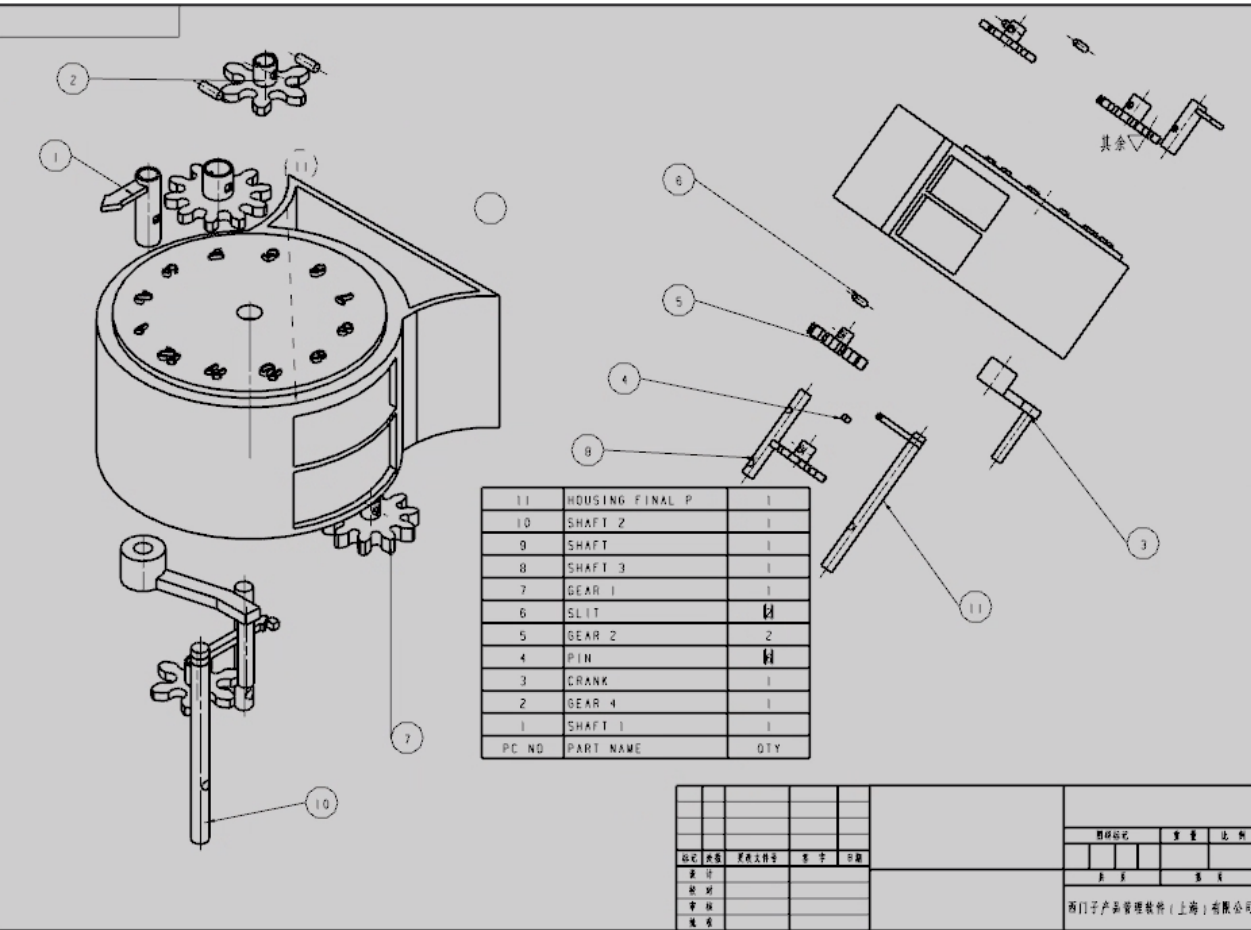
CAD Models

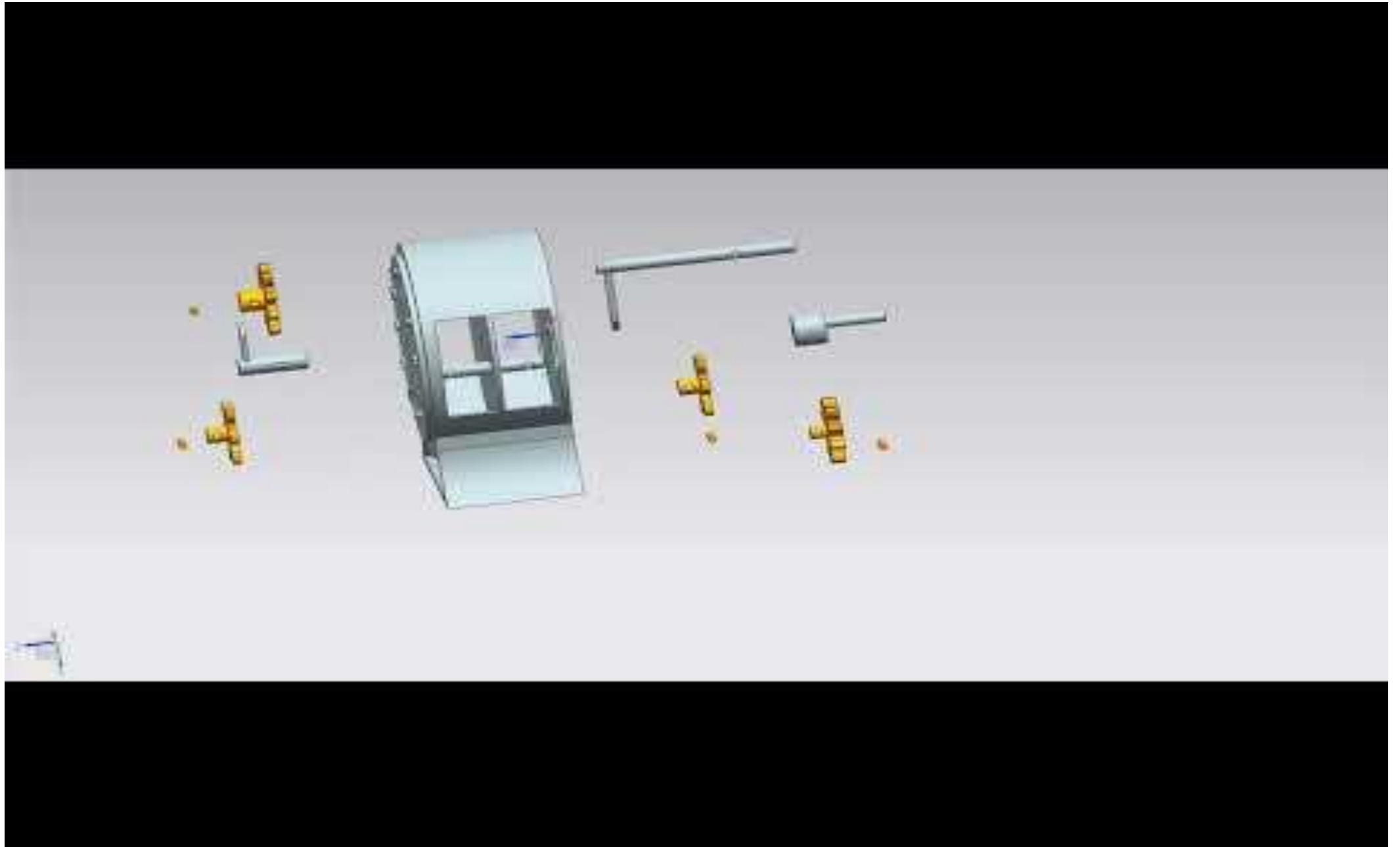
Assembly

- Snapshot of Assembly Model
- Snapshot of Exploded View Drawing / Model
- Video of exploded view



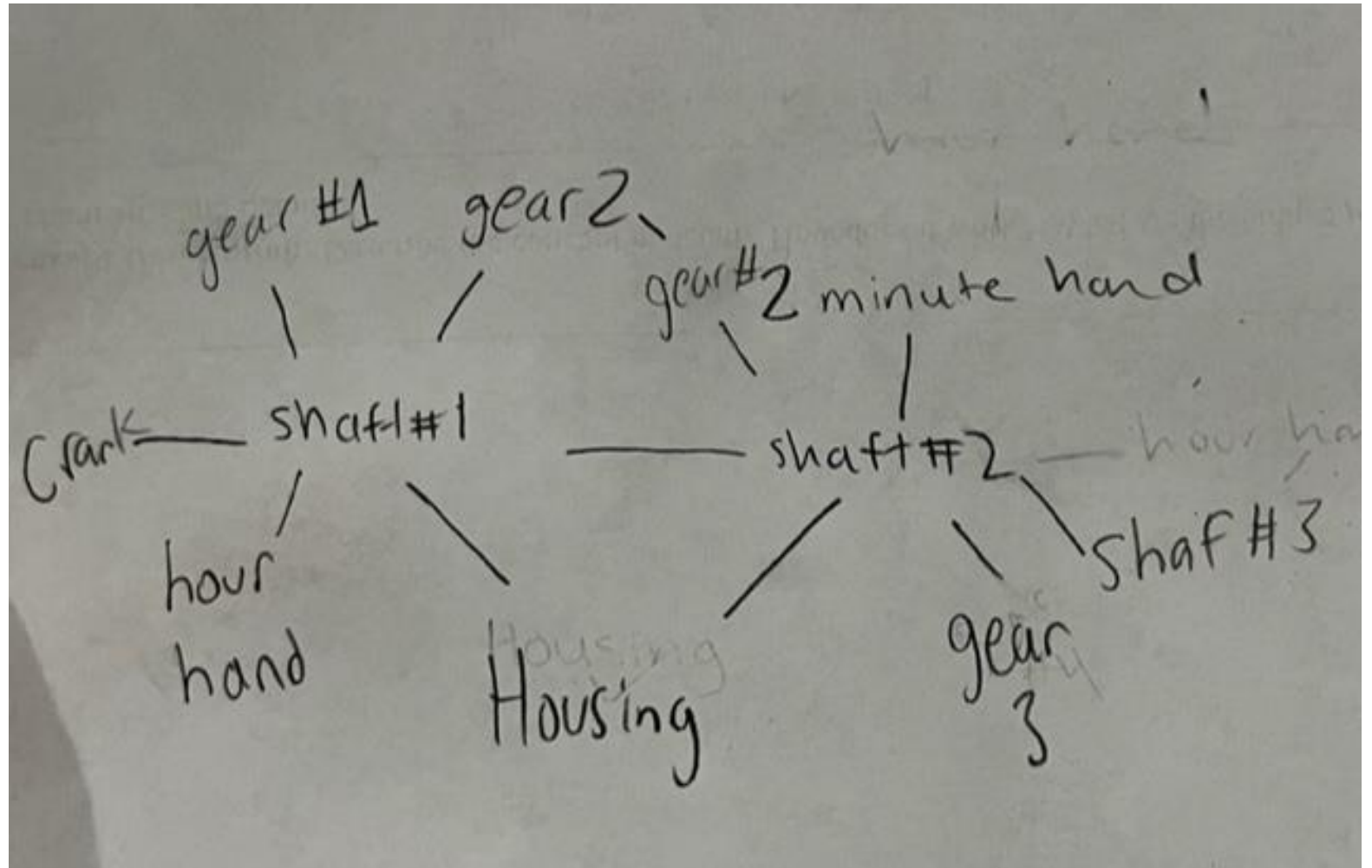
Assembly Exploded view





System Block Diagram / System Design

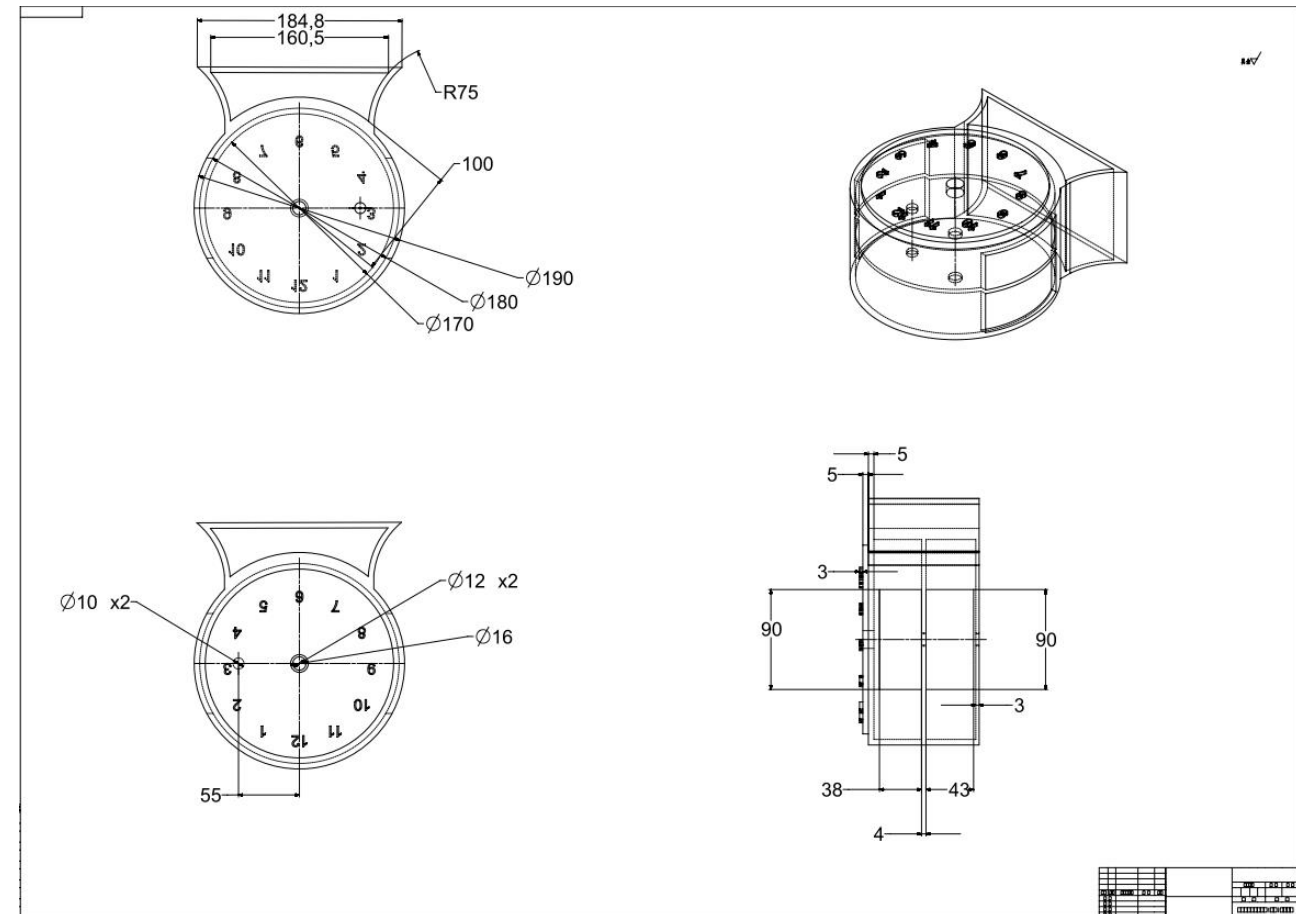
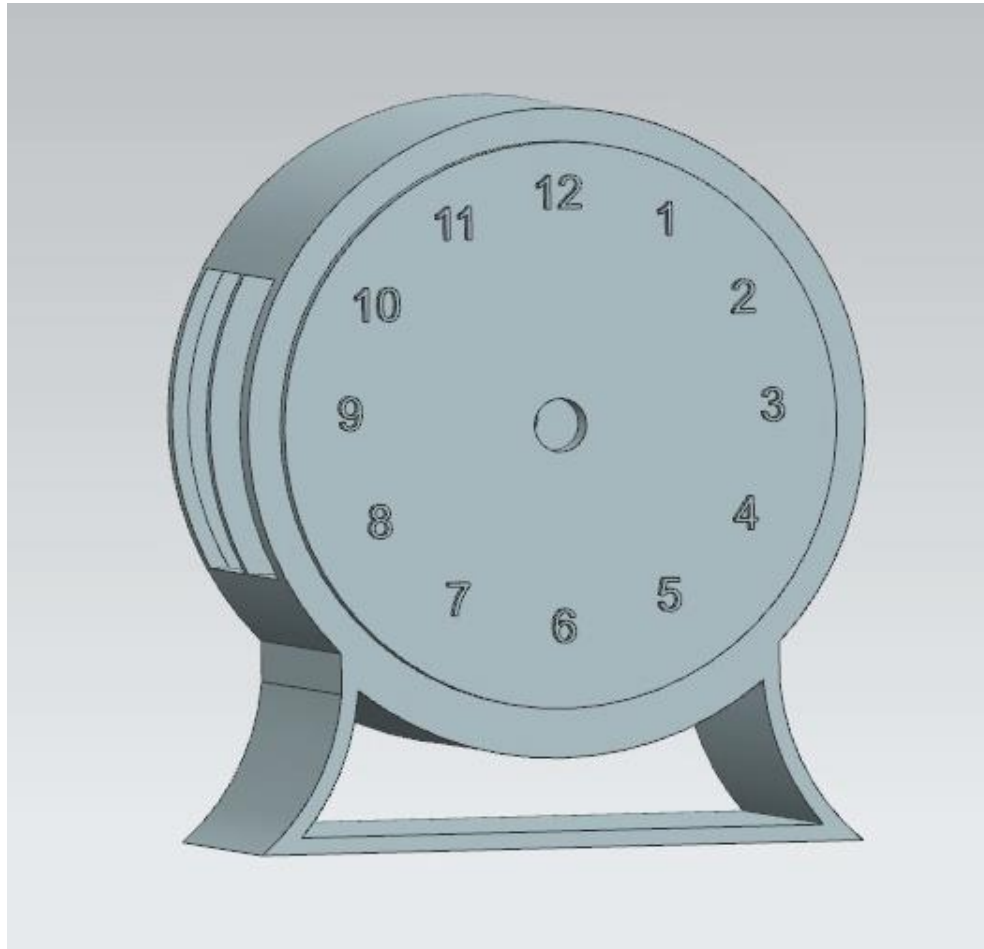
- Pictorial Representation of Design, showing all components and all interfaces in our clock.



Design Outputs

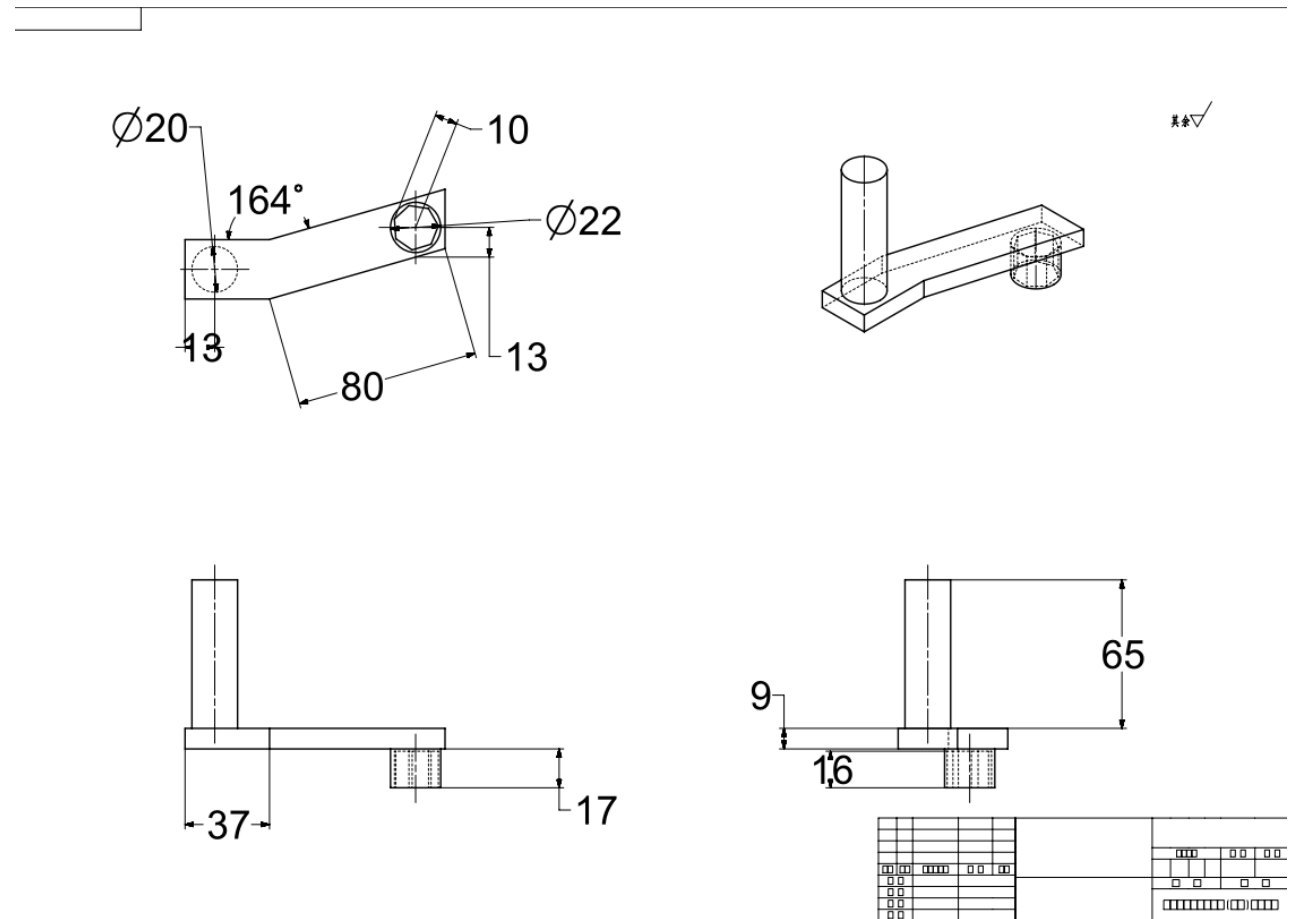
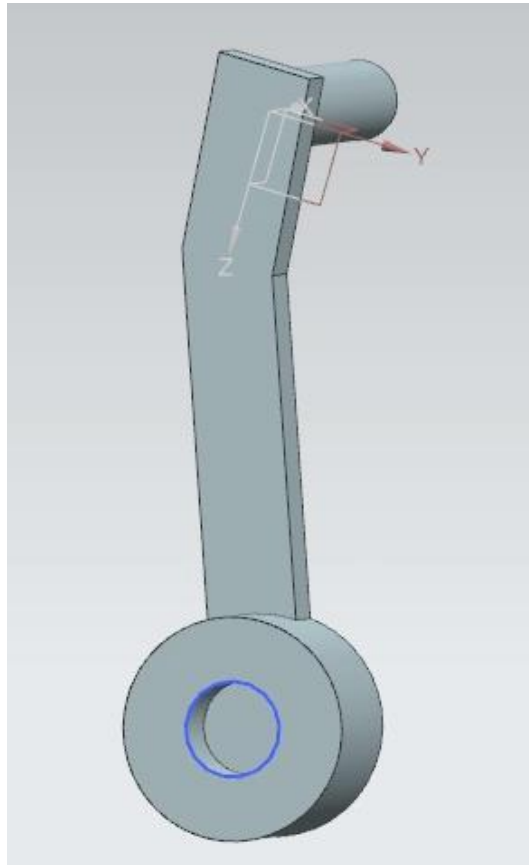
Component Drawings

Housing

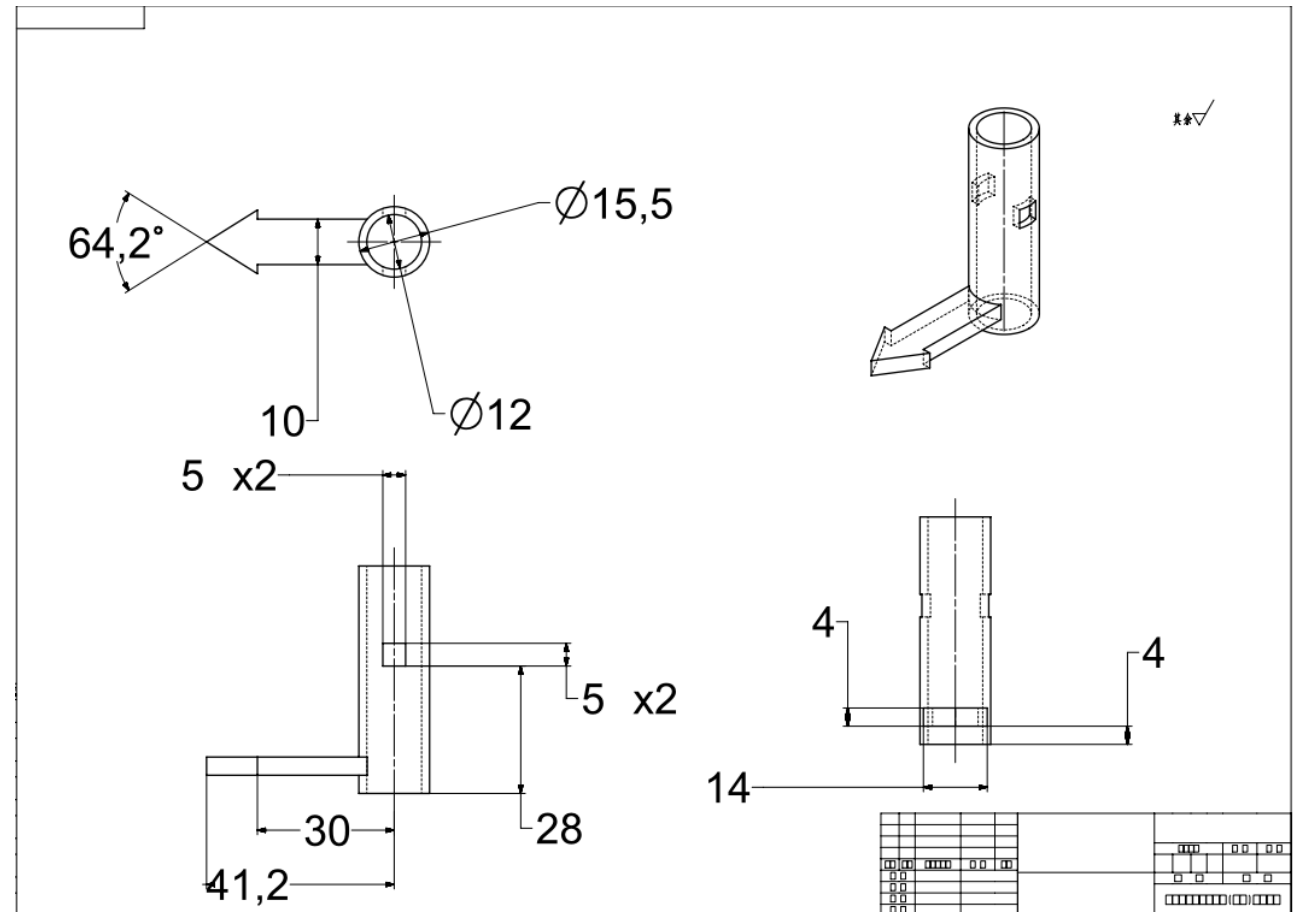
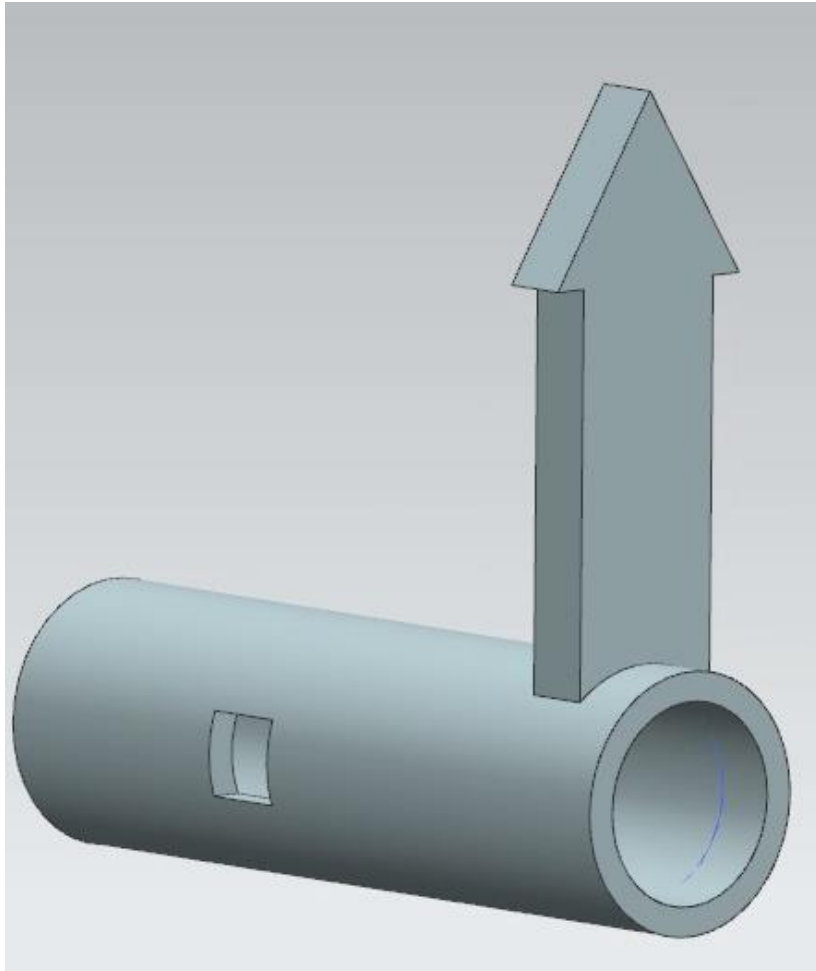


Housing	1	844677	6.61	455	377.17
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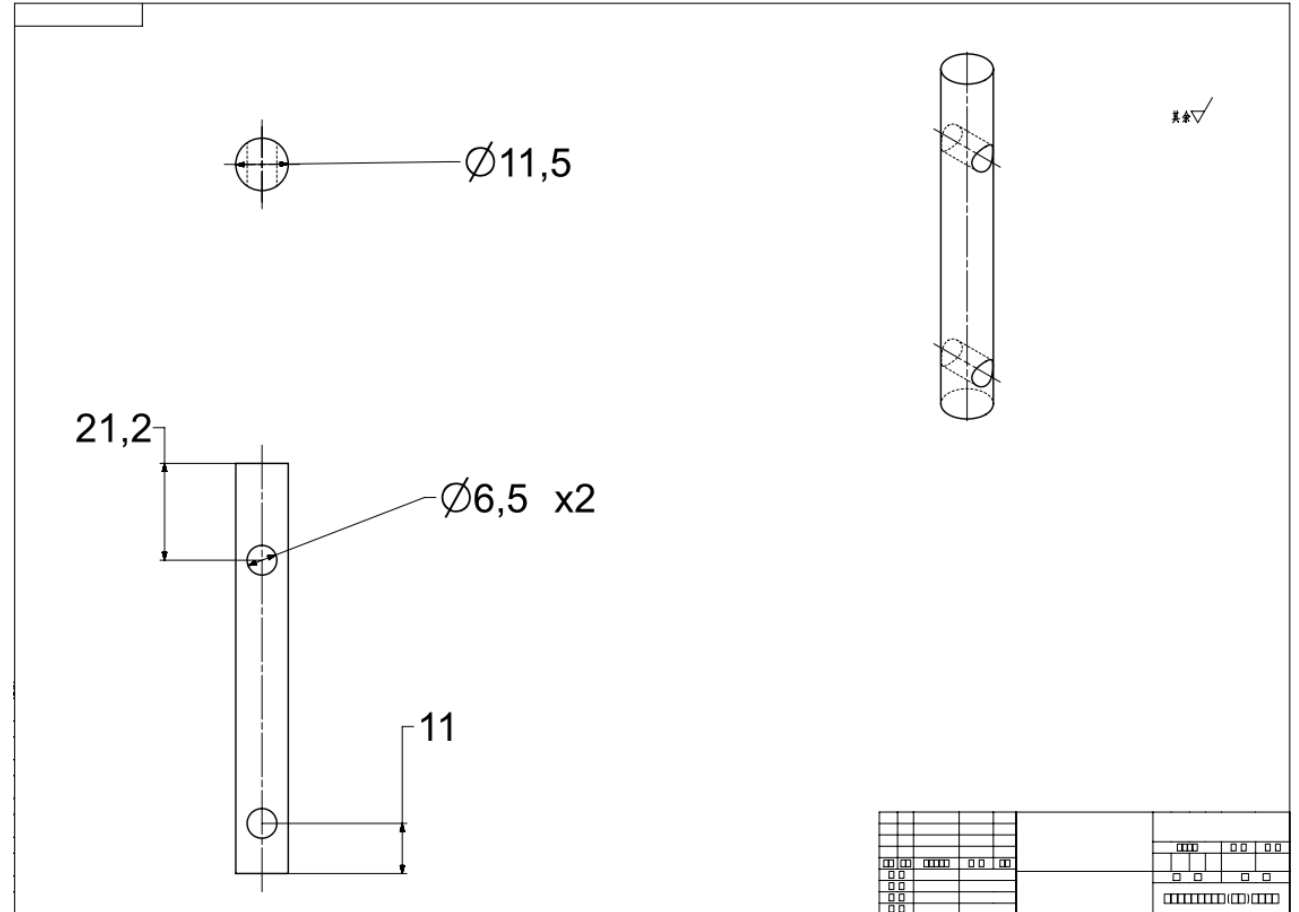
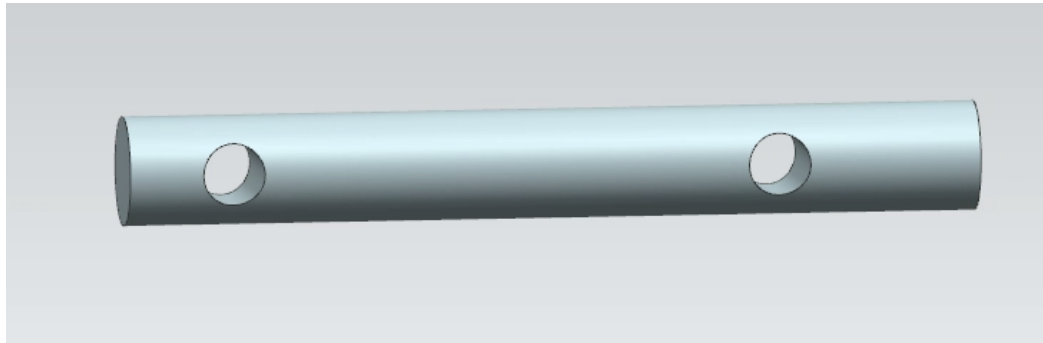
Crank



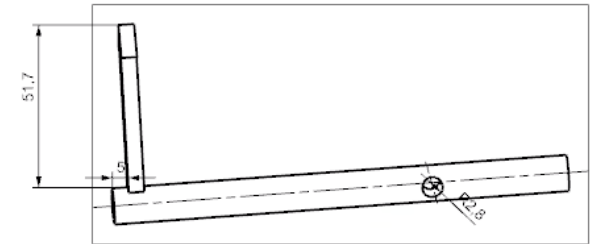
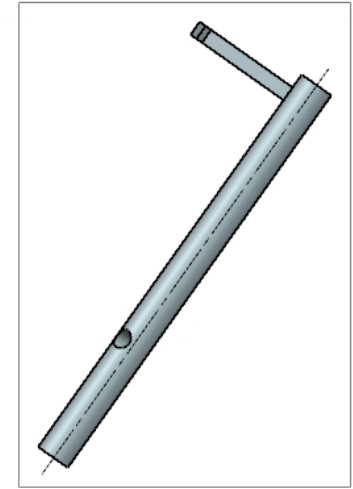
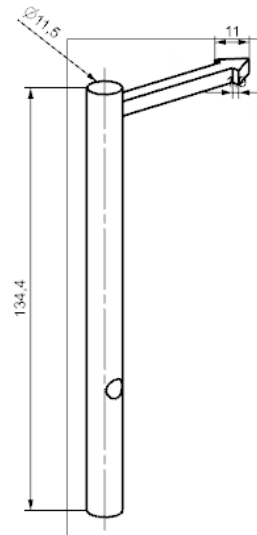
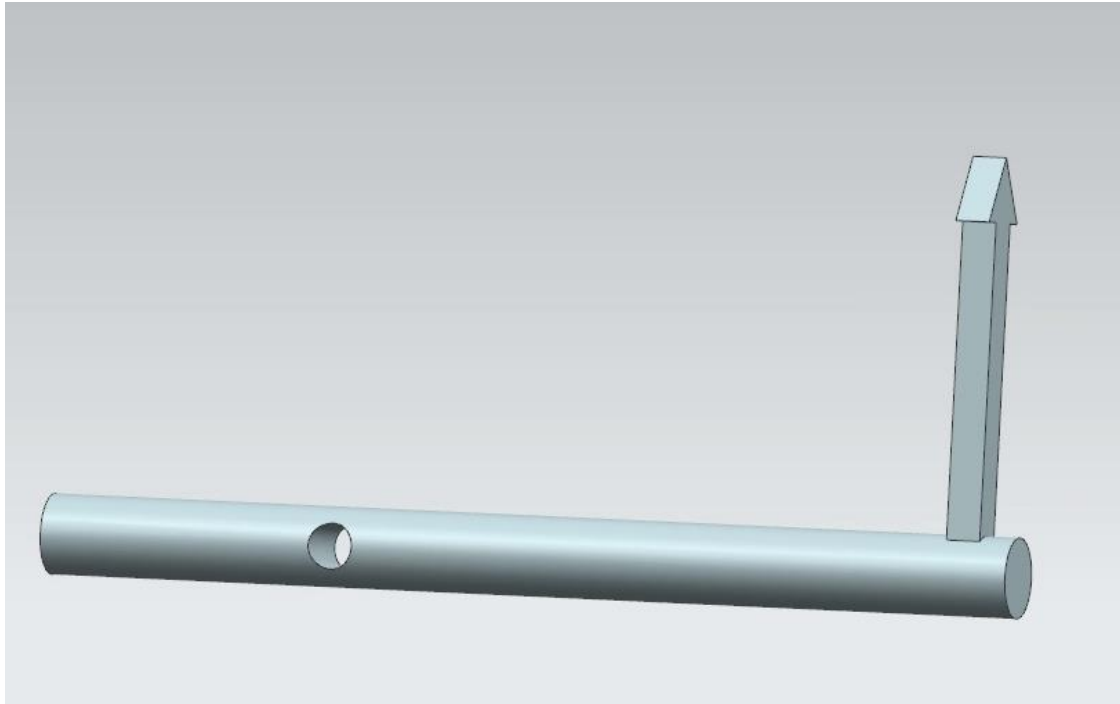
Shaft 1



Shaft 2

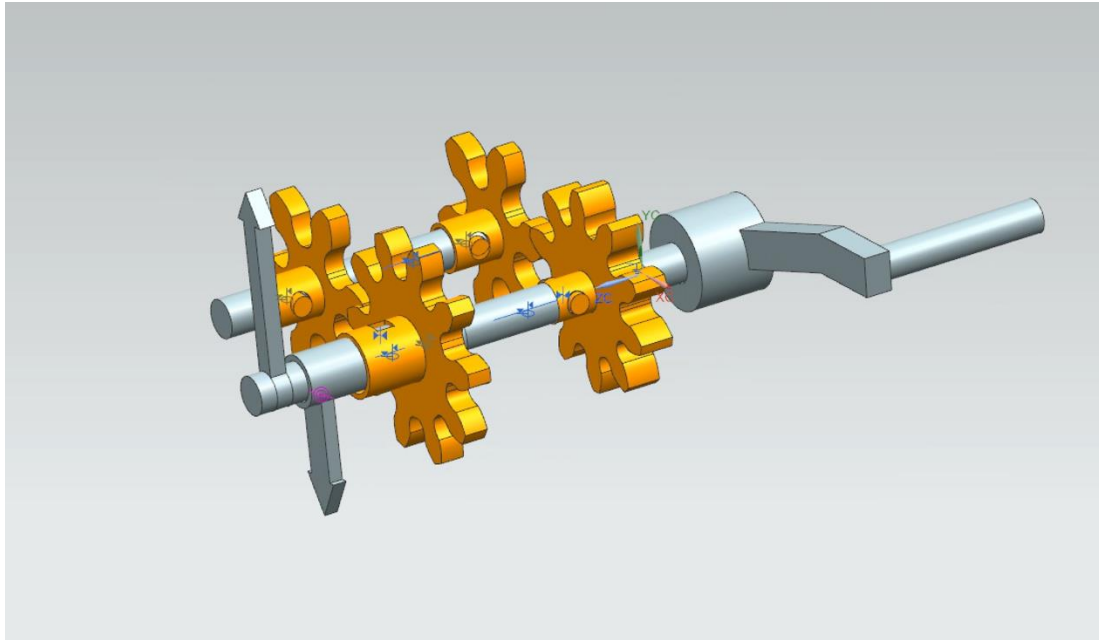


Shaft 3

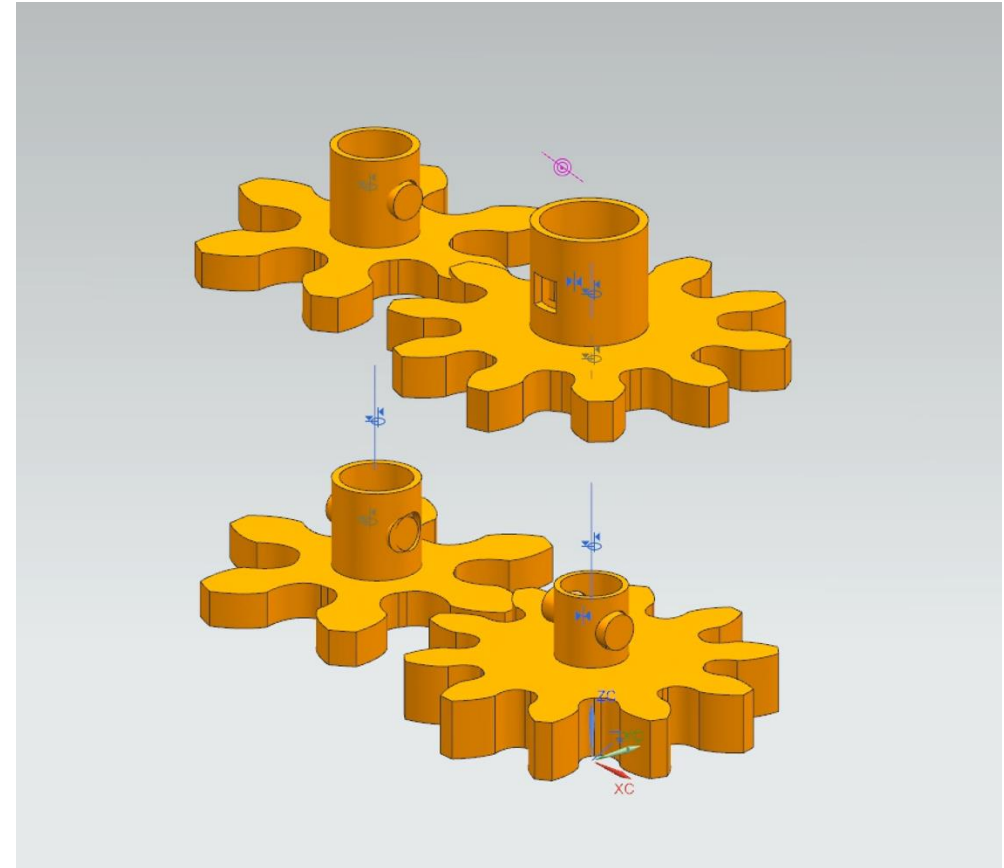


Shaft 3	1	16627	0.13	9.6	5.3
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Gears

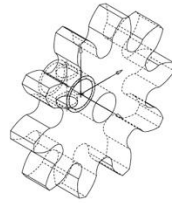
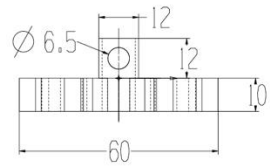


Note: Gear 1 and gear 3 are the same.

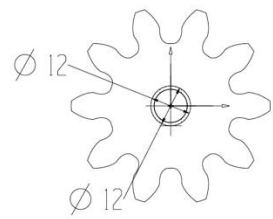
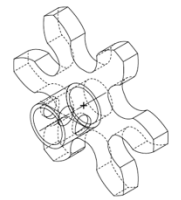
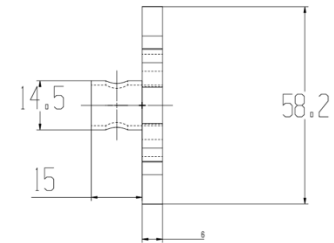


Gears - Draft Drawings:

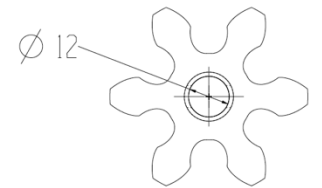
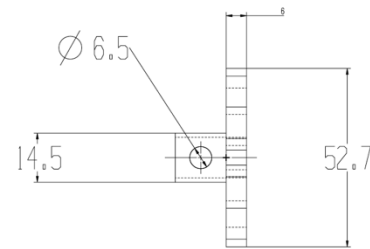
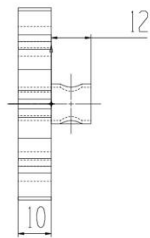
Gear 1/3
N = 10



Gear 2
N = 6*



N = 10

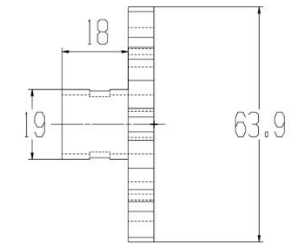
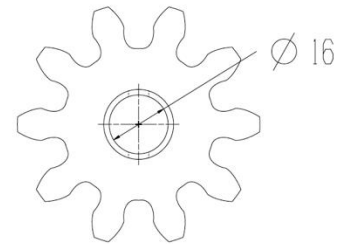
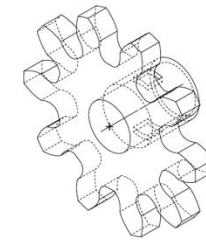
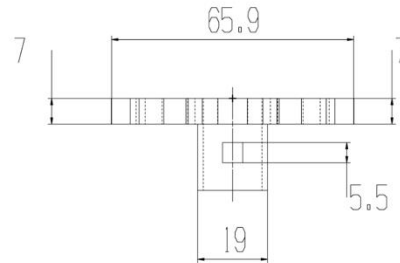


Gear 1	1	18347	0.143	11	5.9
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Gear 2	2	8316	0.065	6.9	7.6
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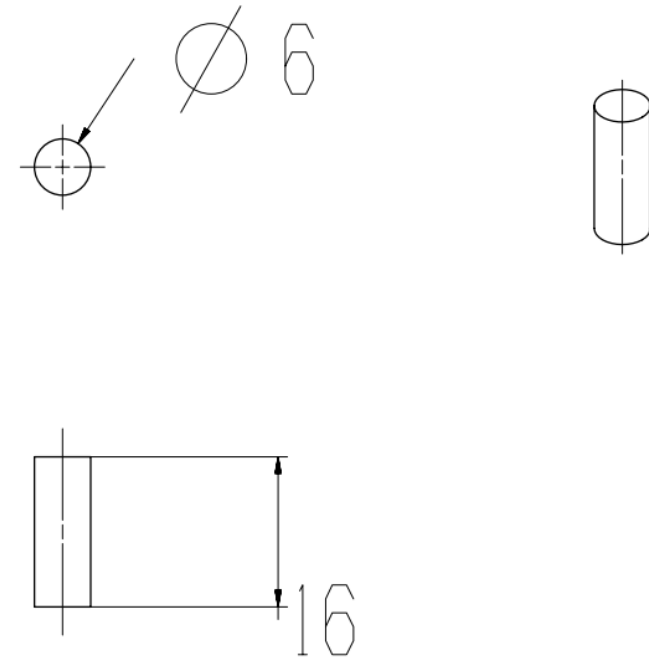
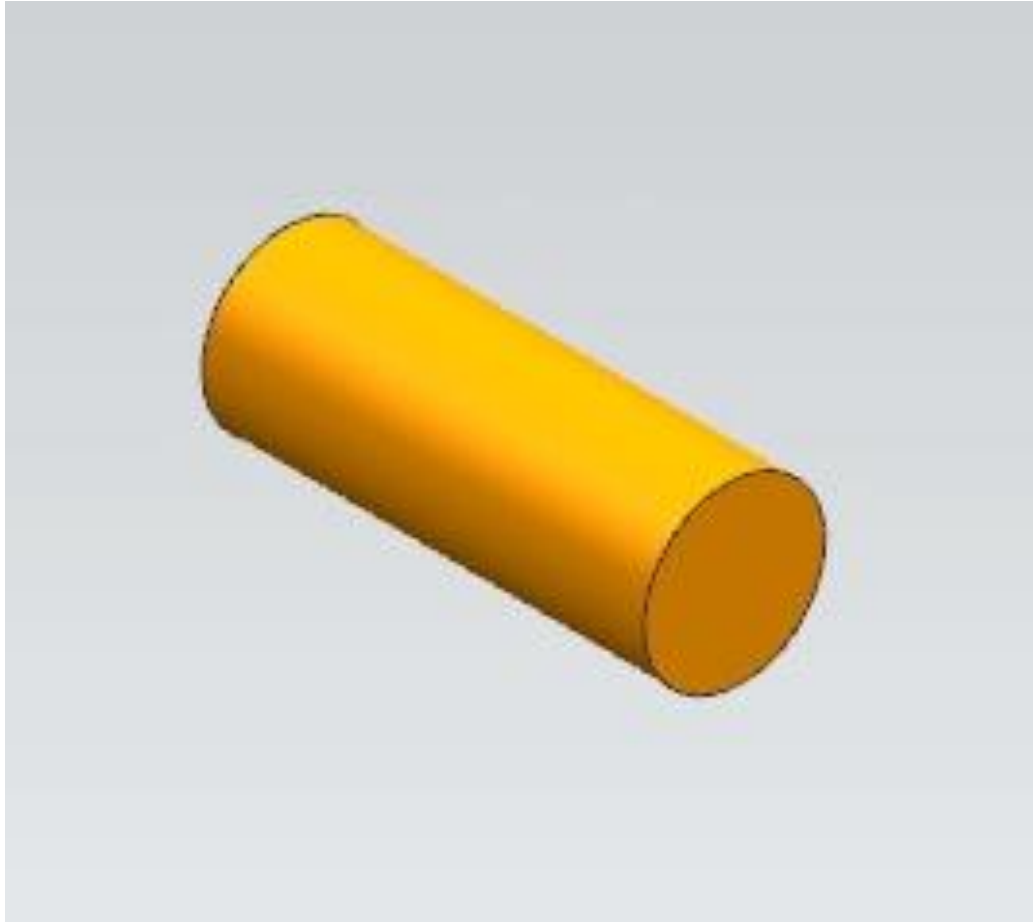
Gears – Draft Drawings

Gear 4
N = 10



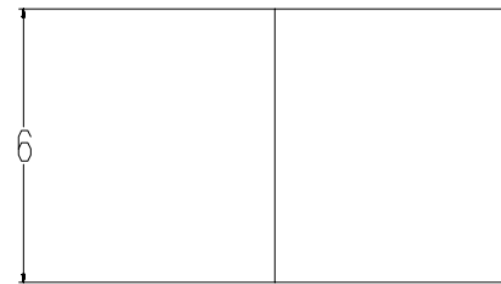
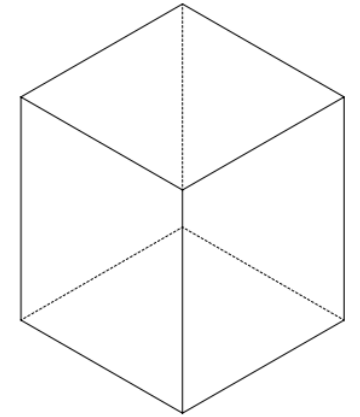
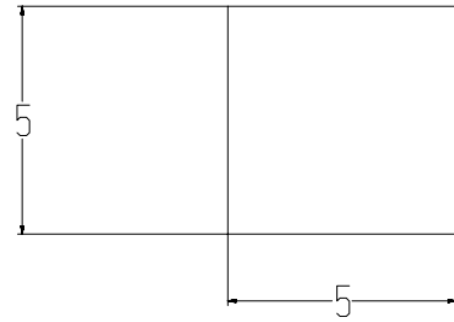
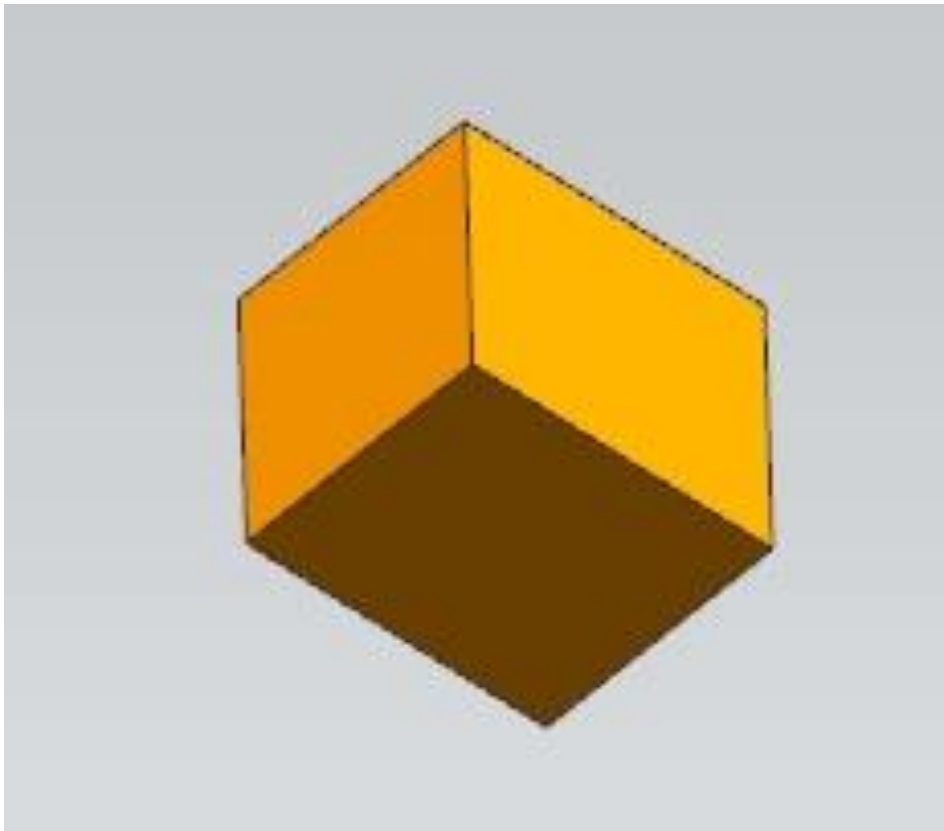
Gear 3	1	15764	0.123	11.7	7.1
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Pin



Pin	6	452	0.0035	3.0	3.0
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Slit



Slit	2	150	0.0018	1.2	0.4
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Design Outputs – Parts List

Part Name	Qty	Volume (mm)	NX Mass (kg)	Cura Mass (g)	Cost (\$)
Housing	1	844677	6.61	455	377.17
Shaft 1	1	4915	0.0385	6	4.18
Shaft 2	1	8617	0.0675	5.9	3.15
Shaft 3	1	16627	0.13	9.6	5.3
Gear 1	1	18347	0.143	11	5.9
Gear 2	2	8316	0.065	6.9	7.6
Gear 3	1	15764	0.123	11.7	7.1
Crank	1	23348	0.183	12.3	6.4
Slit	2	150	0.0018	1.2	0.4
Pin	6	452	0.0035	3.0	3.0
Totals:				522.6	417.2

Problems / Issues

- We ran into a major issue with the gear ratios and the amount of gears to include in our clock
- We could not fit the minute hand and the hour hand onto the shaft
- The cost estimate for the housing was too high and too much material was being used in the print

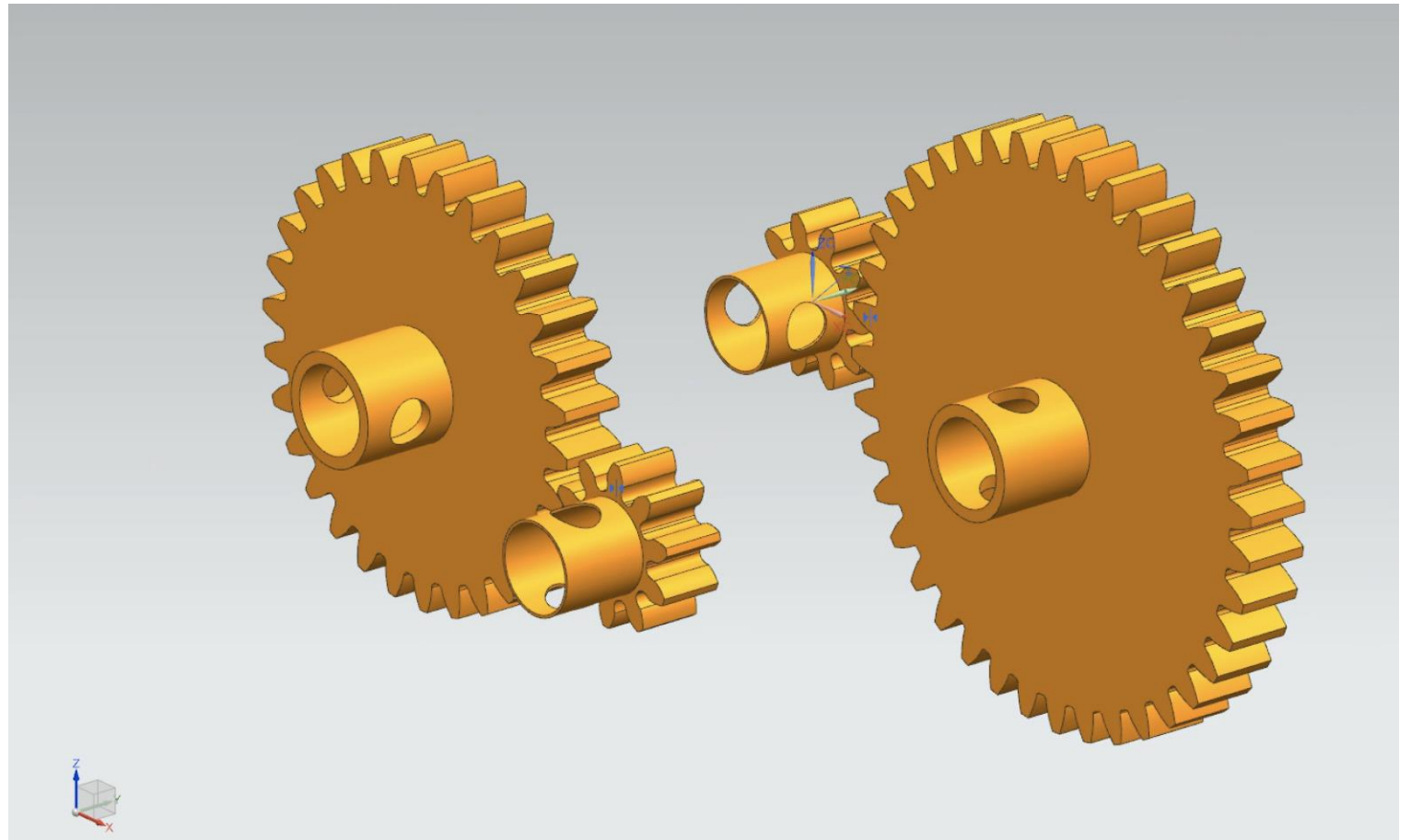
Problem Resolution

- To fix the gear ratio problem, we calculated the amount of gears needed and altered the gear ratio to mimic the gear ratio of a clock
- We instead created a new shaft with the minute hand united onto there so there was no separate minute and hour hand part
- We added the shell feature to the base and reduced the thickness of the walls in the housing to reduce the amount of materials used along with the time printed

Problem Resolution: Gears

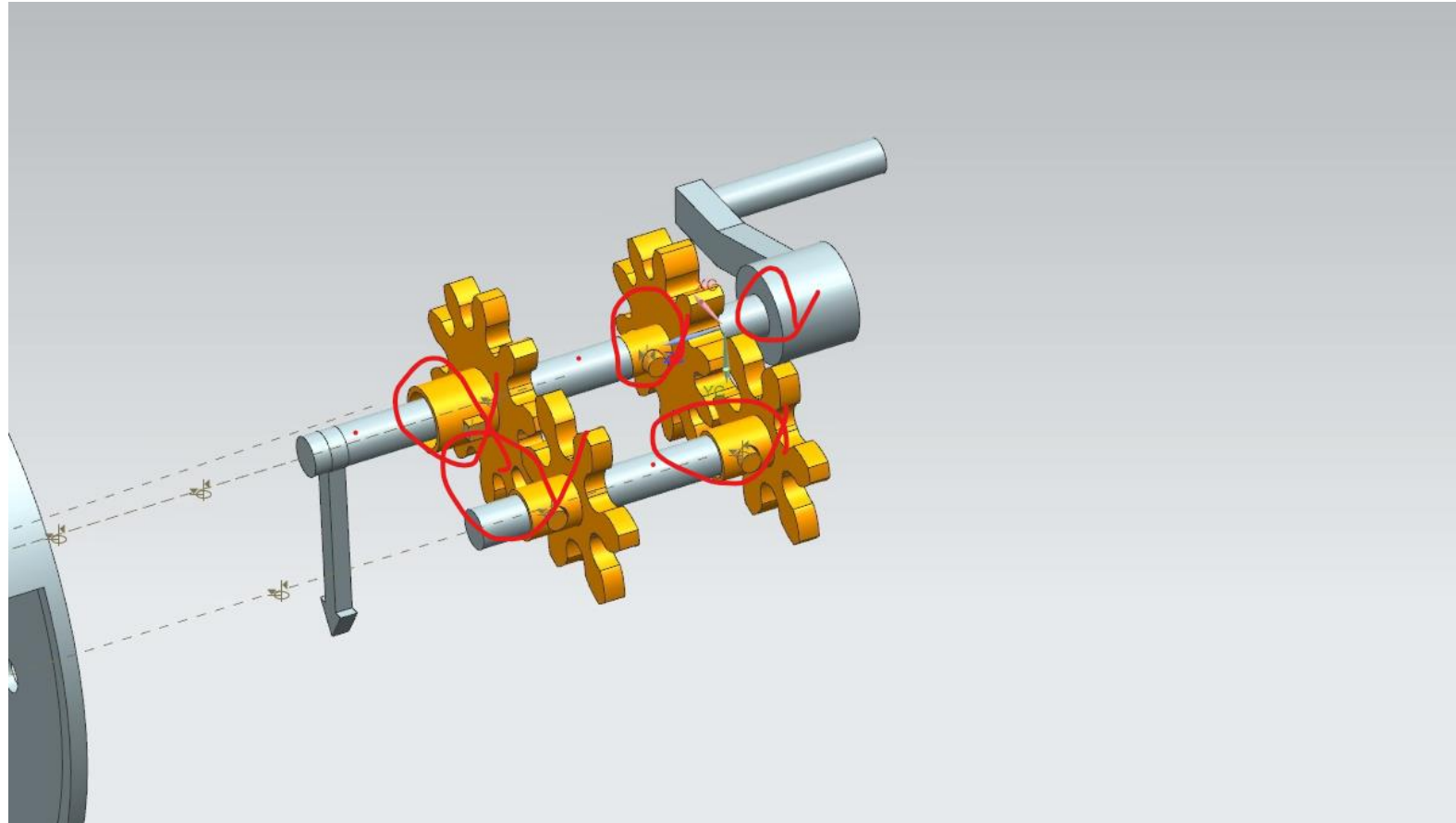
For the minute and hour hands to move proportionally and accurately, the minute hand should make 12 revolutions for every 1 revolution of the hour hand. This requires a gear ratio of 1:12. To the right are the updated gears that accomplish this 1:12 ratio.

For every 12 revolutions that gear 1 (back left) makes, gear 4 (front left) makes 1 revolution.



Test prints

- The interfaces we chose to test print are the ones circled below.
- We also chose to test print the parts where the housing would touch the shafts. Those areas are indicated by the red dots.



Interface Parts

