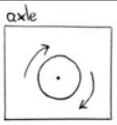
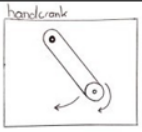
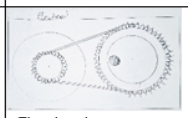
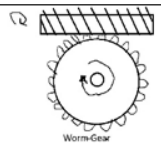
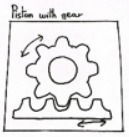
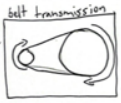
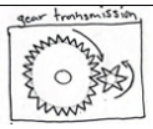
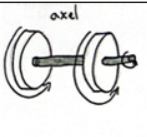
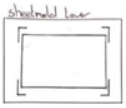
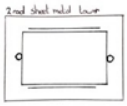
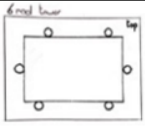
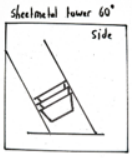
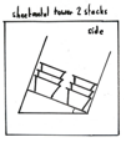
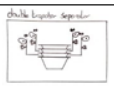
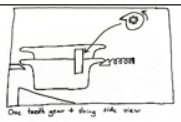
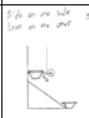
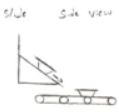
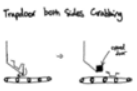
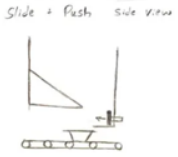
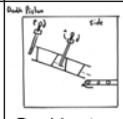
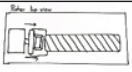
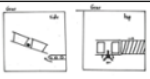
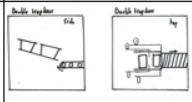
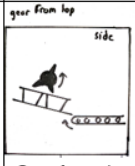
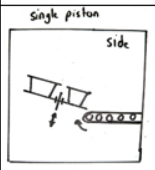
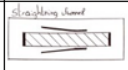
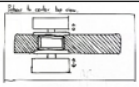
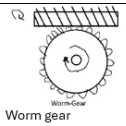
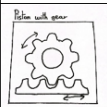
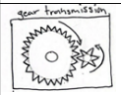
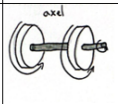
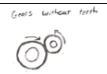
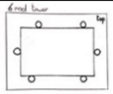
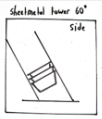
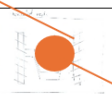
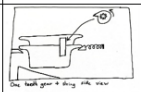
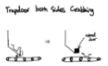
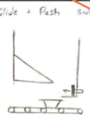
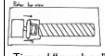
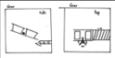
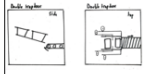
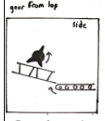
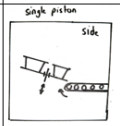
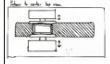
Morphological Sketch List						
Function	1.	2.	3.	4.	5.	6.
Driving mechanism	 Axle	 Hand crank	 Flywheel	 Worm gear	 Piston with gear	
Transmission of forces or motion	 Chains	 Belt transmission	 Gear Transmission	 Axel	 Universal joint	 Gears without teeth
Storing the trays	 Sheetmetal Tower (1st option)	 Sheetmetal tower (2nd option)	 Tower using rods	 Sheetmetal tower on an angel	 Sheetmetal tower with 2 tray stacks	
Separating the trays	 Double “trapdoor” separator	 Using gears to separate	 Using threads to separate	 1 teeth gear and a spring	 Lever/piston design on one end	
Placing	 “Garbage machine” placing	 Slide onto conveyer belt	 “Trapdoor” on both sides	 Slide and pusher	Let it “fall” on the conveyer	
Timed release	 Double piston	 Timed “pusher”	 Gear from the bottom	 Double trapdoor	 Gear from the top	 Single piston
Aligning the trays	 Funnel	 “Pushers” to center	 Funnel with bearings on the sides	No alignment		

Morphological sketch paths with explanation

Path 1: Threaded rod design (concept 1)

Morphological Sketch List

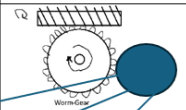
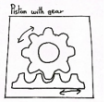
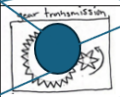
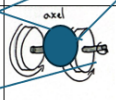
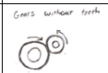
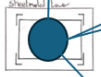
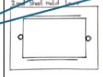
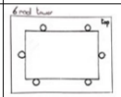
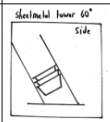
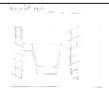
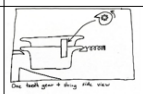
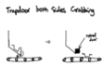
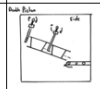
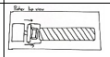
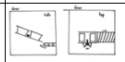
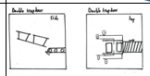
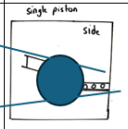
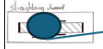
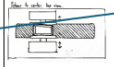
Function	1.	2.	3.	4.	5.	6.
Driving mechanism	 Axle	 Hand crank	 Flywheel	 Worm gear	 Piston with gear	
Transmission of forces or motion	 Chains	 Belt transmission	 Gear Transmission	 Axel	Universal joint	 Gears without teeth
Storing the trays	 Sheetmetal Tower (1st option)	 Sheetmetal tower (2nd option)	 Tower using rods	 Sheetmetal tower on an angel	 Sheetmetal tower with 2 tray stacks	
Separating the trays	 Double “trapdoor” separator	 Using gears to separate	 Using threads to separate	 1 teeth gear and a spring	 Lever/piston design on one end	
Placing	 “Garbage machine” placing	 Slide onto conveyer belt	 “Trapdoor” on both sides	 Slide and pusher	Let it “fall” on the conveyer	
Timed release	 Double piston	 Timed “pusher”	 Gear from the bottom	 Double trapdoor	 Gear from the top	 Single piston
Aligning the trays	 Funnel	 “Pushers” to center	 Funnel with bearings on the sides	No alignment		

Powering the machine by hand is in most cases best done by hand crank, thus it is used in this design as the other two concept designs. To separate a threaded rod is used to force the trays down and separate them in the process. To power this a belt transmission is used, since the threaded rods are on the corner of the trays. Using a belt to power the system makes it less complex then using gears.

This design does not use a separate system for placing down the trays since the trays are forcibly separated. The trays are released just above the conveyer. Since a threaded rod is already timed there is also no timed release used. The threaded rods also double up as a “funnel” of some sorts, aligning the trays that go through.

Path 2: Gear system (concept 2)

Morphological Sketch List

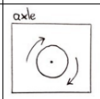
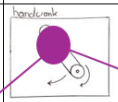
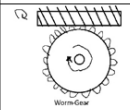
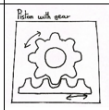
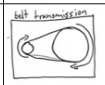
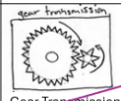
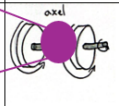
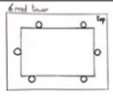
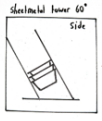
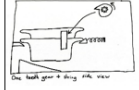
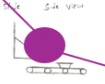
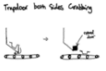
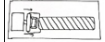
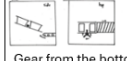
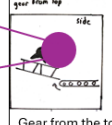
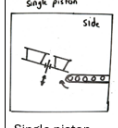
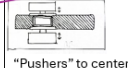
Function	1.	2.	3.	4.	5.	6.
Driving mechanism	 Axle	 Hand crank	 Flywheel	 Worm gear	 Piston with gear	
Transmission of forces or motion	 Chains	 Belt transmission	 Gear Transmission	 Axel	 Universal joint	 Gears without teeth
Storing the trays	 Sheetmetal tower (1st option)	 Sheetmetal tower (2nd option)	 Tower using rods	 Sheetmetal tower on an angel	 Sheetmetal tower with 2 tray stacks	
Separating the trays	 Double “trapdoor” separator	 Using gears to separate	 Using threads to separate	 1 teeth gear and a spring	 Lever/piston design on one end	
Placing	 “Garbage machine” placing	 Slide onto conveyer belt	 “Trapdoor” on both sides	 Slide and pusher	Let it “fall” on the conveyer	
Timed release	 Double piston	 Timed “pusher”	 Gear from the bottom	 Double trapdoor	 Gear from the top	 Single piston
Aligning the trays	 Funnel	 “Pushers” to center	 Funnel with bearings on the sides	No alignment		

The transmission of this machine consist mainly of gears, but also uses axels and chains. To store the trays, this system uses a sheetmetal tower, so that the trays go into the system straightend.

The system uses a gear system to separate the system, from where the trays slide down a “slide” that doubles up as a funnel. After which a single piston system makes sure the separated trays get released.

Path 3: Double piston (concept 3)

Morphological Sketch List

Function	1.	2.	3.	4.	5.	6.
Driving mechanism	 Axle	 Hand crank	 Flywheel	 Worm gear	 Piston with gear	
Transmission of forces or motion	 Chains	 Belt transmission	 Gear Transmission	 Axel	 Universal joint	 Gears without teeth
Storing the trays	 Sheetmetal Tower (1st option)	 Sheetmetal tower (2nd option)	 Tower using rods	 Sheetmetal tower on an angel	 Sheetmetal tower with 2 tray stacks	
Separating the trays	 Double “trapdoor” separator	 Using gears to separate	 Using threads to separate	 1 teeth gear and a spring	 Lever/piston design on one end	
Placing	 “Garbage machine” placing	 Slide onto conveyer belt	 “Trapdoor” on both sides	 Slide and pusher	Let it “fall” on the conveyer	
Timed release	 Double piston	 Timed “pusher”	 Gear from the bottom	 Double trapdoor	 Gear from the top	 Single piston
Aligning the trays	 Funnel	 “Pushers” to center	 Funnel with bearings on the sides	No alignment		

This system uses a similar transmission as concept two. Trays are stored in a sheetmetal tower, since the trays must be in a straight tower before the separation. A double piston system releases the trays one by one, stopping the rest from falling.

The tray is then placed onto a “slide” and straightened out by a funnel. The trays are then released one by one by a gear from above. This gear then releases the trays one at a time and acts like a second “security” point in case the double piston fails.