AAKRUTI 2023

Shaping Imagination

InfiniSort: Simplify the Sorting

Theme: Sustainable Mobility

Team Name: Karna

Team ID: A23-71184

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Final design Submission

3DEXPERIENCE Edu

SOLIDWORKS

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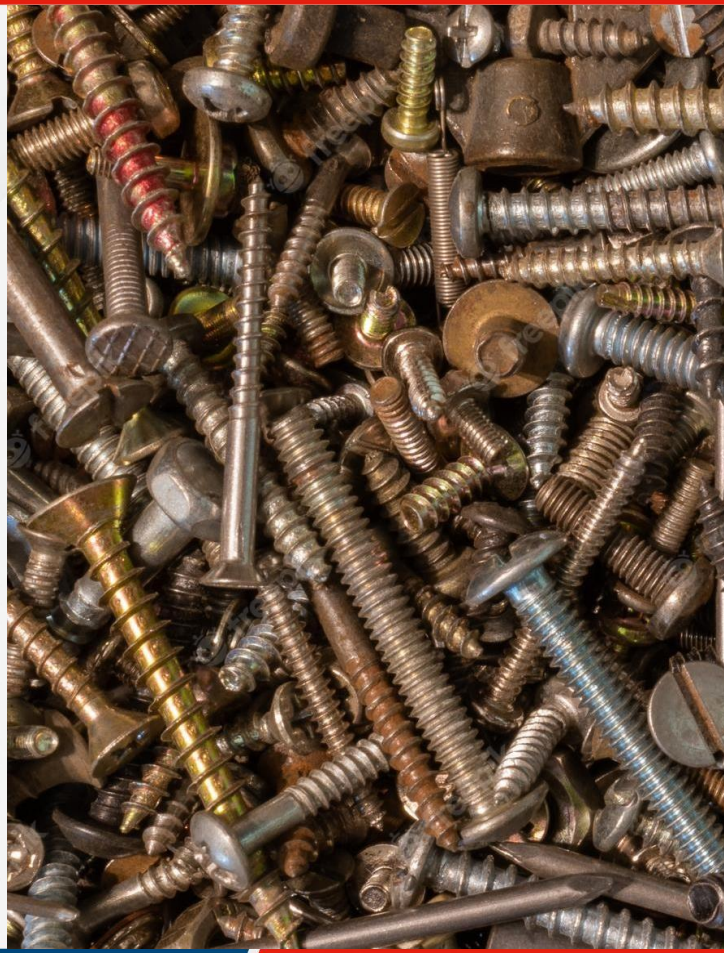
Problem Identified - Difficulty in Sorting of mixed sized fasteners

PROBLEM DESCRIPTION

- Many industries, usually which deal with assemblies, face the problem of sorting of unused fasteners in mixed sizes .
- In an assembly, different types of fasteners are used and are often thrown in a common bin if not used and this leads to mixing of fasteners.

PROBLEM BACKGROUND:

- Sorting mixed sized fasteners is a labour-intensive & time-consuming work.
- The current solutions available in market are
    - Expensive
    - Occupy more space
    - Maintenance cost is high and
    - Skilled labour is required due to expensive sensors
- So, affordability for small and medium scale industries is challenged.



Significance

WHY IS IT AN URGENT PROBLEM?

- **Improve Efficiency -** In a manufacturing some of the most important things are lead time and workers' efficiency. Every industry is constantly looking for ways it can decrease lead time and increase efficiency.
- **Productivity Improvement -** Many industries use **'Kaizen'** to increase efficiency. Kaizen make subtle changes to increase the productivity of a worker.
- **Lead time Reduction -** To decrease lead times, uses better machines and better tools. Well, our machine does both! It reduces lead times by providing workers with necessary fasteners all the time and it increases the productivity of a worker.

Research findings

This research is for products available in market

- Complex Automation Solutions
- Expensive solutions
- Occupy more space
- Skilled labor is required
- High maintenance is required
- Less affordability
- Portability is low
- Low possibility of integration with other systems

User Persona – Factory Owner

PROFILE & DEMOGRAPHICS

Job Title: Owner
Gender: Male/Female
Family and Social Setting: Respected Figure
Income: 10,00,000 to 18,00,000 INR
Education: B.Tech, MTech, MBA

ATTITUDES & MOTIVATION

Attitudes: Smart work makes work easier
Beliefs: Opportunities don't happen, you must create them
Motivations: To increase the productivity of the factory.

TASKS

Activities: Increase productivity, improve efficiency and effective use of manpower.

PAIN POINTS

Fears: Not completing the daily target
Frustrations: Machine breakdowns, no cheap alternatives available in market
Challenges: To complete the task smartly and efficiently

FEELINGS

Worries: Training of workers and high maintenance cost

User Persona – Assembly line worker

PROFILE & DEMOGRAPHICS

Job Title: Work in assembly line.
Gender: Male/Female
Family and Social Setting: Bread winner, low-income group
Income: 12,000 to 18,000 INR
Education: ITI/ Diploma

ATTITUDES & MOTIVATION

Attitudes: To complete the task smartly and smoothly without extra efforts
Beliefs: Make it possible
Motivations: Awards, rewards, intensive motivation and recognition in the company

TASKS

Activities: To assemble the final product.
Resources available: Components of product and fastener

PAIN POINTS

Fears: Not completing the daily target
Frustrations: Always getting mixed sized fasteners
Challenges: To finish the task with ease and in less time

FEELINGS

Worries: Pressure to complete work

User Persona - Member of SAE BAJA Team

PROFILE & DEMOGRAPHICS

Job Title: Suspension and Steering Member
Gender: Male/Female
Family and Social Setting: Student
Income: NA
Education: Pursuing B.Tech

ATTITUDES & MOTIVATION

Attitudes: Creative and innovative
Beliefs: Failure is the key to success
Motivations: Social empowerment

TASKS

Activities: To assemble the wheel assembly with the chassis
Resources available: Hub, knuckle, brake assembly, Wishbone, bolts, nuts and washers

PAIN POINTS

Fears: Break down of parts
Frustrations: Not find the specific size of the bolt and nut.
Challenges: To provide the solution for completion the task smartly and effectively

FEELINGS

Worries: Deadlines

Product specifications

Components required
- Refer table 1

Technical requirements
- Fabrication is required for the body and the different funnels that will lead to different bins.
- Working and properly calibrating the circuit as per requirement.

Human factors
- Skilled labour is required for manufacturing
- No special training required

Constraints
- Making sure that a bolt goes through the exit of feeder with the same orientation.
- Only metal bolts can be sorted out.
- The current arrangement can only sort two sizes of bolt, M10 and M8. In future, improvements will be made so that the machine will be able to sort all types of fasteners.

Table 1: BOM

Components	Specification	Make / Buy
Vibratory Feeder	MS Sheet metal	Make
Vibratory motor	1500 RPM	Buy
Arduino Nano	ATmega328	Buy
Feeder Base	MS Square pipes	Bake
Plywood Base and Supports	10mm Thick Plywood	Make
M8 Nut Bolts	Hexagonal Head	Buy
Servo motor	+5V	Buy
Tensile Springs	9.8 N/mm	Buy
Battery	12 Volt Replaceable	Buy
M5 Nut Bolts	Hexagonal Head	Buy
Metal strips	2 good conductor metal strips	Buy

Final solution and innovation

HOW DOES YOUR SOLUTION ADDRESS THE PROBLEM IDENTIFIED?

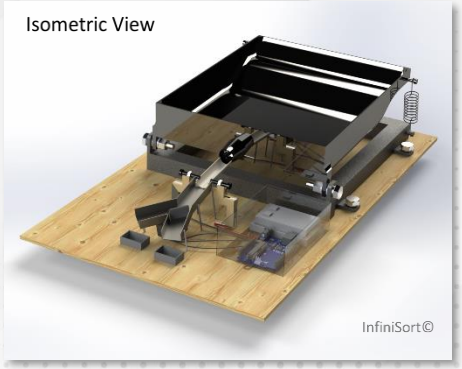
HOW IS IT INNOVATIVE?

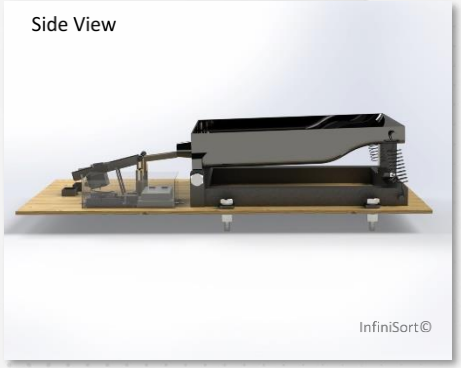
Using our machine - **InfiniSort** reduces lead times in assembly lines. Which leads to increase in productivity.

InfiniSort Characterizes

- Has less investment
- Low maintenance cost because of its simple automation design
- It is compact
- It is light in weight
- Is easy to use
- No special training required

Final CAD Product Images





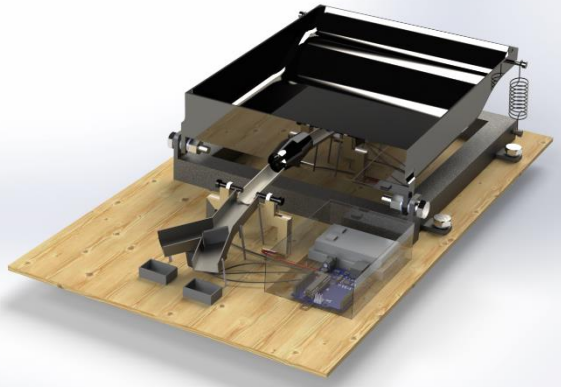
InfiniSort©

Simplify the Sorting

Product details

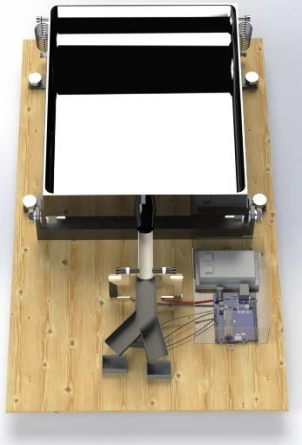
- InfiniSort includes a vibratory feeder, small guideway, Y-shaped path distributor, wooden base, Arduino nano, servo motors, 12V battery, plastic casing for electrical components.
- The feeder is made of sheet metal and has a base made of stainless steel. The small guideway is made of plastic. The Y-shaped path is also made of plastic.
- The bolts will simultaneously come out of the feeder and will go through the guideway. There will be two bolts attached to the sides of the guideway which could be adjusted according to the requirements.
- If the bolt is of large size (example M10), it's head will touch the bolts. This will complete a circuit and will send a high signal to the Arduino. The Arduino will give instructions to the servo motors. The servo motor will change the direction of a small plastic flap which will guide the bolt to its specified bin.
- If the bolt is small (example M8), it's head will not touch the bolts and the circuit will not complete. This will not give a signal to the Arduino and the servo motor will not move the flap.

Isometric View



InfiniSort©

Top View



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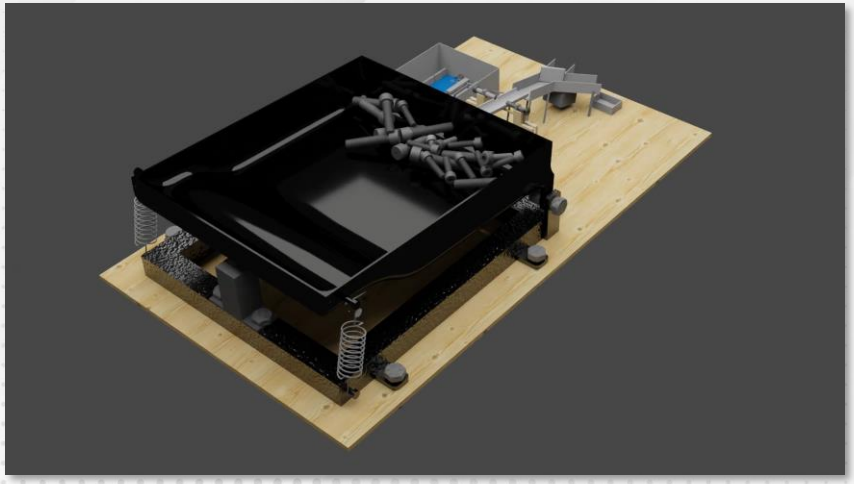
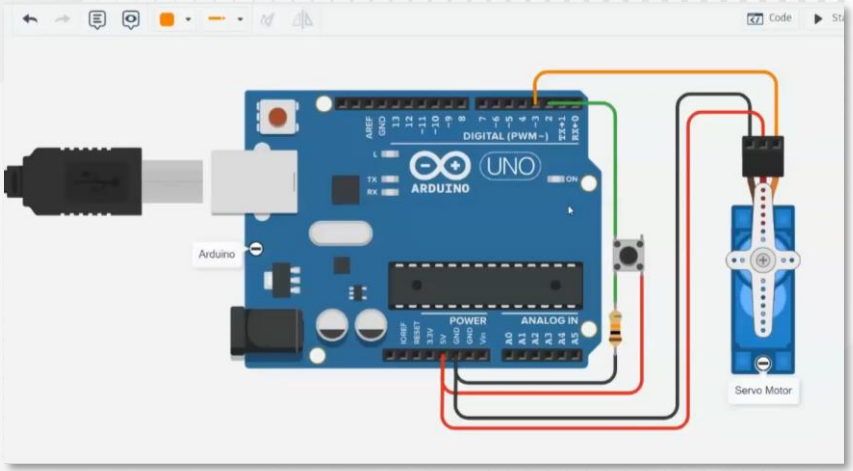
Product simulation





Product reflection

InfiniSort provides following over current market solution

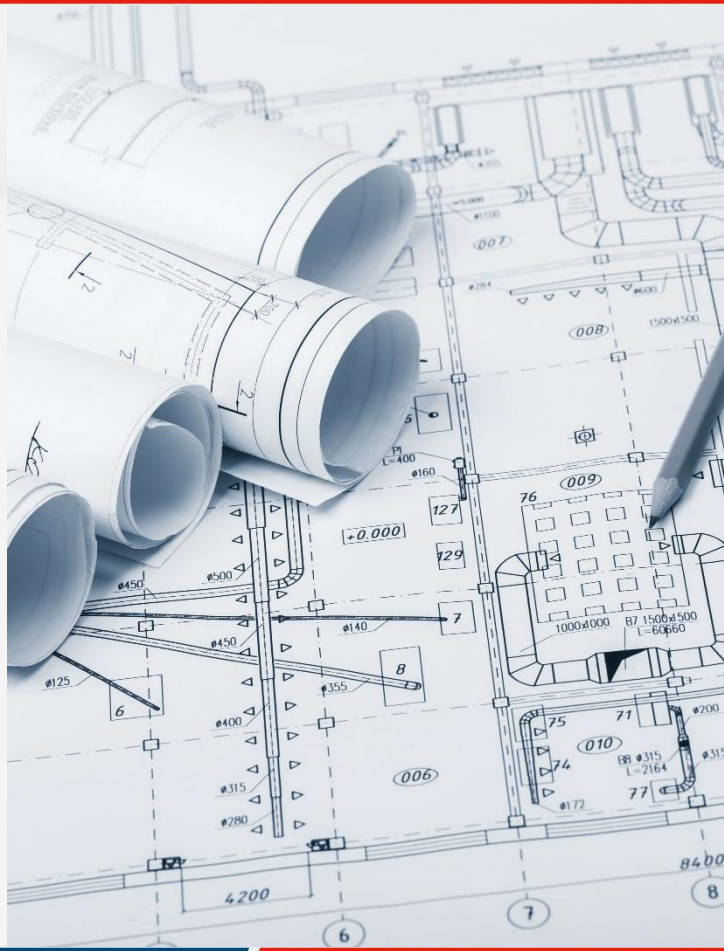
- Simple Automation
- Compact Design
- Occupy less space
- No special training is required
- Further improvements can be made in design
- Low Maintenance
- More Affordability
- Portability is high
- Easy to use
- Will be able to sort all fasteners

Design process

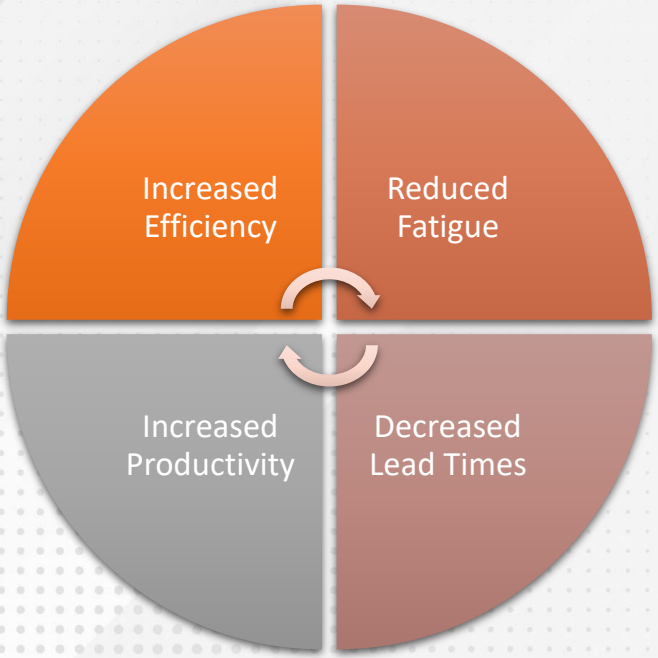
Explored different types of feeders → Selected vibratory bowl feeder → Encountered problems with bowl feeder

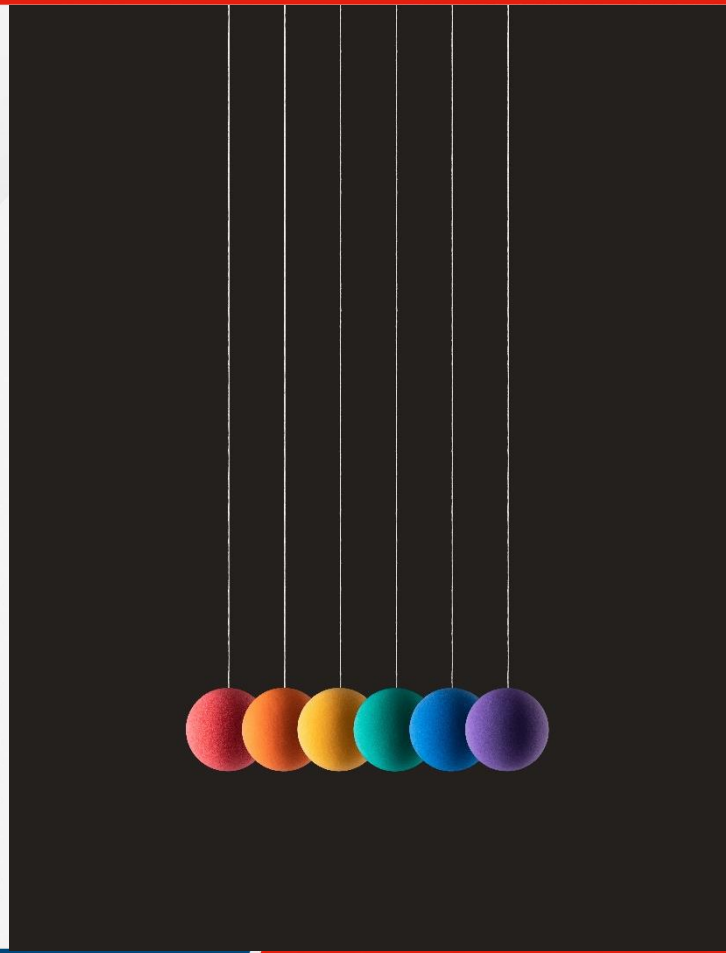
Bowl feeder is expensive, and the orientation of bolts was not proper → Settled on simple vibratory feeder → Explored different types of sensors

Sensors were very expensive and complicated → Explored ways to omit sensors → Finalized the current design



Impact of your solution

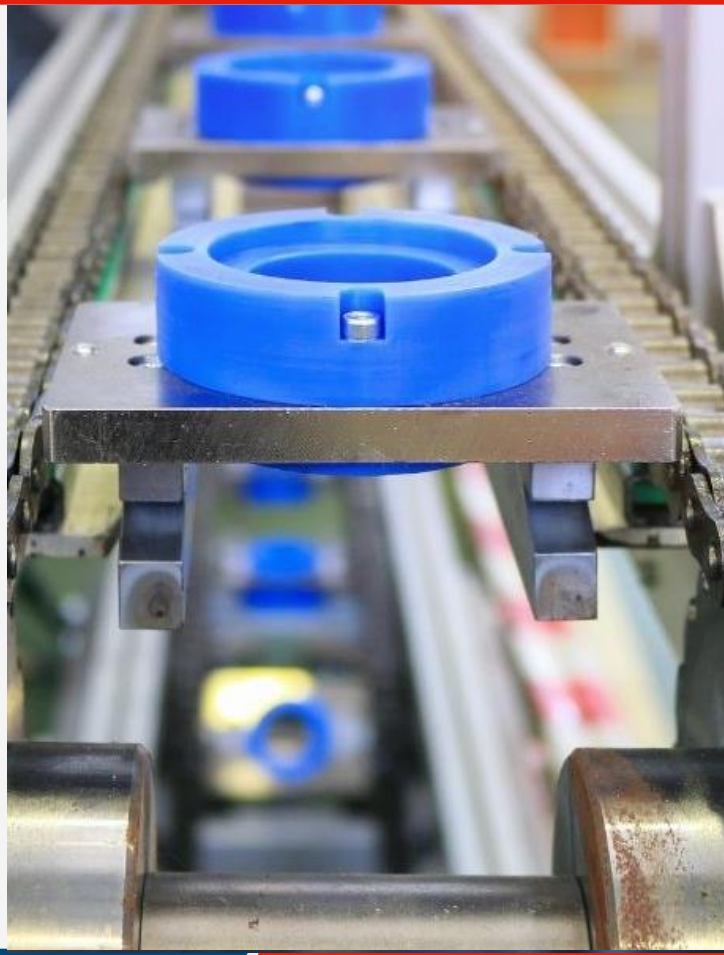




Sustainability – Relationship with the 3 R's

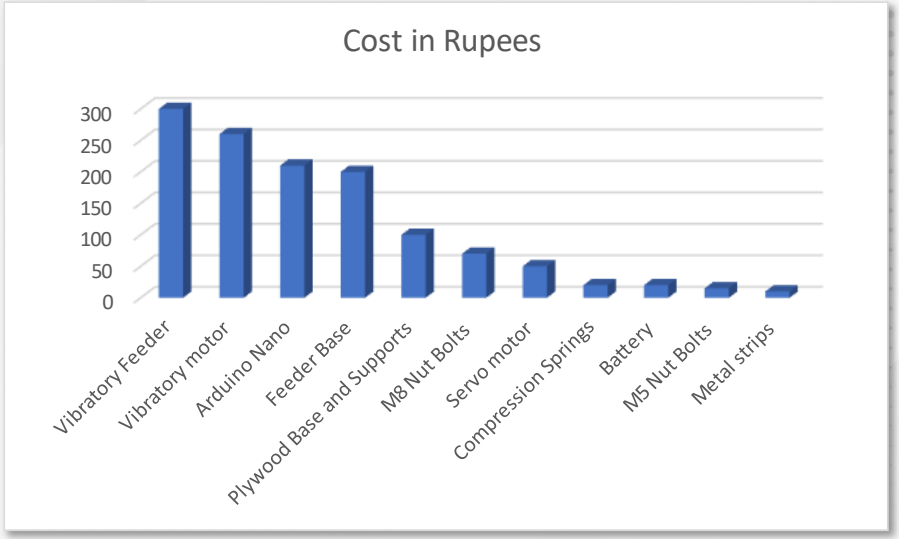
Future Scope

1. Sorting different sizes of bolts
2. Sorting all fasteners including nonmetal
3. Integrated with conveyors along with hoppers
4. Automatic bin system can be added
…Furthermore



Material Costing

Components	Specification	Cost in INR
Vibratory Feeder	MS Sheet metal	300
Vibratory motor	1500 RPM	260
Arduino Nano	ATmega328	210
Feeder Base	MS Square pipes	200
Plywood Base and Supports	10mm Thick Plywood	100
M8 Nut Bolts	Hexagonal Head	70
Servo motor	+5V	50
Tensile Springs	9.8 N/mm	20
Battery	12 Volt Replaceable	20
M5 Nut Bolts	Hexagonal Head	15
Metal strips	2 good conductor metal strips	10
Total Cost		1255



Basic Cost Calculations :

Product Costing	
Material Cost	₹ 1,255.00
Process Cost	₹ 1,700.00
Total Assembly cost	₹ 3,015.00
Profit (20%)	₹ 603.00
Ex-work price	₹ 3,618.00
Selling Price	**₹ 4,000.00**
Margin available for sell price	₹ 382.00

Capital Investment	
Tools & Dies	₹ 50,000.00
Assembly Machinery	₹ 50,000.00
Infrastructure	₹ 1,00,000.00
Rent Deposit	₹ 60,000.00
Total Investment	**₹ 2,60,000.00**

Profit Before Tax.	₹ 603.00
Yearly Profit (Considering Qty.900/year)	₹ 5,42,700.00

Capital Investment	Profit with one Year	ROI
₹ 2,60,000.00	₹ 5,42,700.00	209%
Yearly overhead expenses = ₹ 4,80,000		

Conclusion

Our Solution InfiniSort-

- Is Affordable
- Is compact and portable
- Is simple automated
- Is easy to use
- Is sustainable
- Has high future scope

Thank You!!