

## **Dharmaj Technologies, Surat-Gujarat, India - 2024**

Dharmaj Technologies located in Surat (Gujrat). One of the leading organizations dedicated to manufacturing and supplying an exceptional range of Laser & Non-Laser Diamond Processing Machinery.

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At Dharmaj technologies I had an opportunity to learn the real-life application of two engineering marvels. These directly connected to my prior background Theoretical Knowledge of Physics. For instance, the application of motors is somewhat similar to a servo motor but at a larger scale was quite evident in the robotic arm referred to as Vajra Mani (Automatic Robotic arm Polishing Bench). Moreover, the precise use of software analysis alongside, use of axis and sensors were all underscored in this machine. I also got the opportunity to view the manufacturing process and the interior of the Vajra Mani, accentuating the working of the axis motors, sensors and the software running processors.

The diamond cutting tool also known as RatnaKanti (Laser Diamond Faceting Machine) skillfully employed specific laser-based technology to slice through tough gems. Over here I learned the working of how optimum laser beam conditions are attained. I learned the entire process of how the laser beam is generated, and where does it start, how is the frequency doubled using specific materials, and as it starts from a pulse all the way ending up cutting a diamond. This learning experience enhanced my practical knowledge regarding waves and optics, integrating the real-world application of this theory in me.

With further discussion and understanding both products had huge impact compared to traditional industry practice. Better Turnaround time by eliminating few processes, multiple process at one go, Value addition (Better recovery on Lasers whereas minimal to no damages observed on high value and high stress gems), simpler operations.

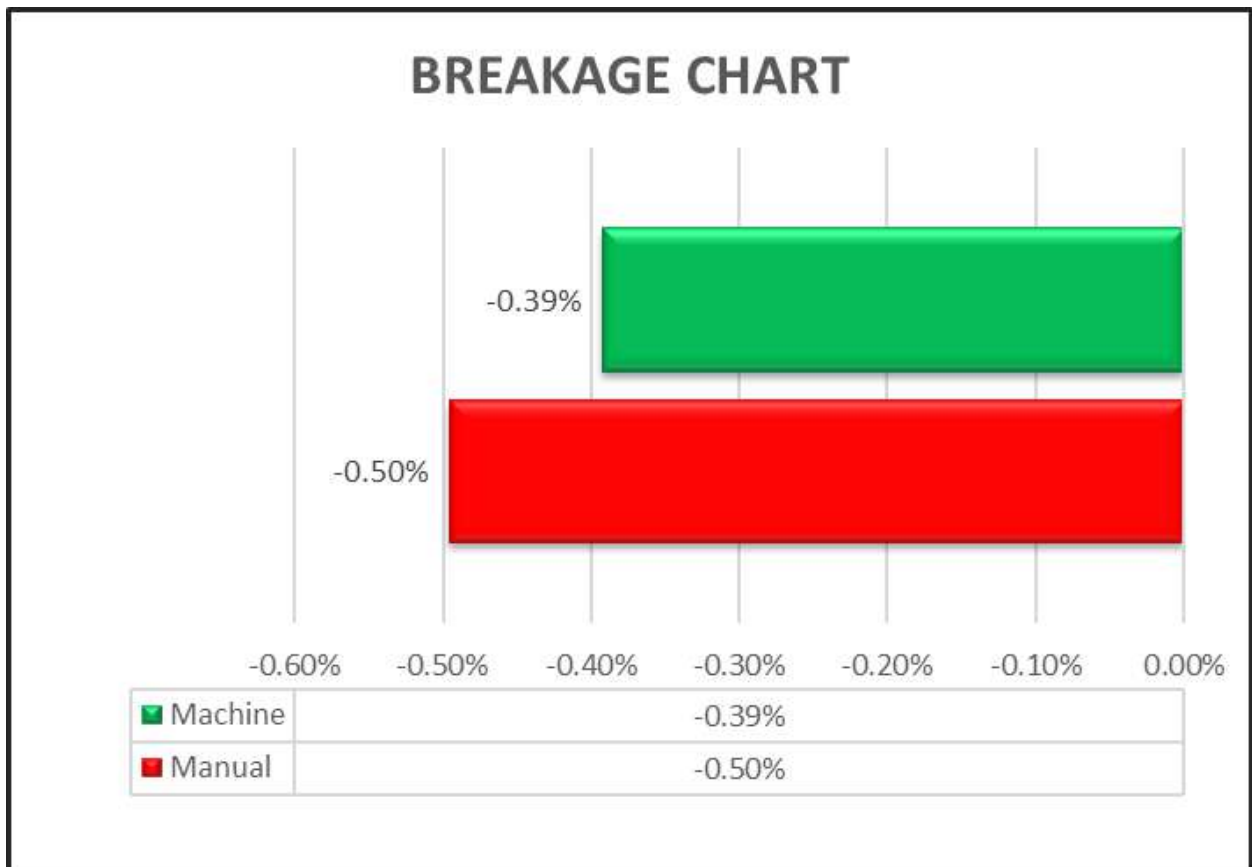
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Developed by Dharmaj Tech, Vajra Mani is an advanced automated machine designed to polish diamonds with precision using a robotic arm powered by six servo motors, enabling movement along the X, Y, and Z axes. Controlled by software named Nirdeshak, users import an .OBJ file or manually input parameters, then set a central point for the diamond via a camera interface before defining facet edges for cutting, leaving 100 nanometers for polishing. The arm's movement is scaled in CPM (cycle per mm), with each motor connected to a driver for control. The system features the VMC card to manage camera gates, water flow, and other functions, ensuring efficient and accurate operation. The camera gates, operated by a stepper motor, protect the camera from dust and water, while water flow is regulated to match operational needs. It is a fully automated process and can be remotely monitored.

It is majorly used for High Value & High Stressed Gems where manual polishing can lead to high damage due to varied pressure ranging from 1000gm to 1500 gms, where as here the pressure is pre-decided 25 gms on the gem.

## Analysis : Manual ↔ Machine

|  |   |         |
|--|---|---------|
| Process Type (High-Very High Value & Stress Goods) | Manual  | Machine |
| Breakage Value In %                                | -0.50%  | -0.39%  |
| Impact Of Breakage In Stones                       | Breakage Reduced By 20.80% Compared To Manual Process |         |



The RatnKanti machine, also known as the Laser-assisted Faceting machine, utilizes ND-YAG laser technology in green and infrared versions to cut both natural and synthetic diamonds with extreme precision, offering 8 to 16 facets per side. It operates with the Sarine Advisor 8 program, allowing for accurate cutting of asymmetrical shapes via .OBJ file input. The machine maximizes yield and minimizes errors by leveraging wave characteristics. The laser beam is enhanced through a series of mirrors, splitters, and benders, converting the infrared beam to a green wavelength in the visible spectrum for cutting. Servo-controlled components rotate the diamond along the X, Y, and Z axes for precise cuts, while a semi-axis card manages the logic control system, ensuring stability and reducing the need for frequent adjustments.

| <b>Analysis : Manual ↔ Machine</b> |          |           |                    |               |
|------------------------------------|----------|-----------|--------------------|---------------|
| Process                            | Machines | Man Power | Production / Month | Expense/Month |
| Ratn Kanti                         | 12       | 23        | 7800               | 701500        |
| Manual                             | 25       | 75        | 7800               | 1875000       |

## Expense



## Man Power

