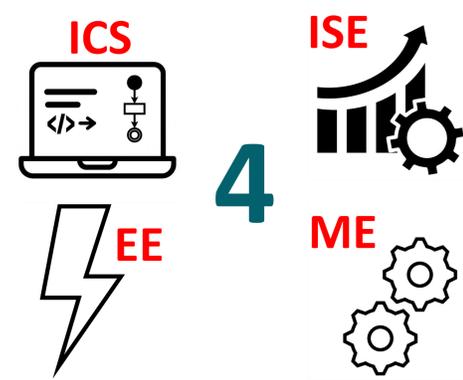


Efficient Tile Planning with Laser Marking Assistant

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➤ Introduction

Manual tile marking in construction leads to excessive material waste, labor inefficiency, and estimation errors. This project introduces an automated tile engraving machine guided by an optimization model to improve accuracy, reduce waste, and streamline the process while meeting safety standards.

➤ Problem Statement

Tiling often results in excess waste and inefficiency due to manual marking and poor estimation. This project introduces an automated engraving machine guided by an optimization model to enhance precision and reduce material loss safely.

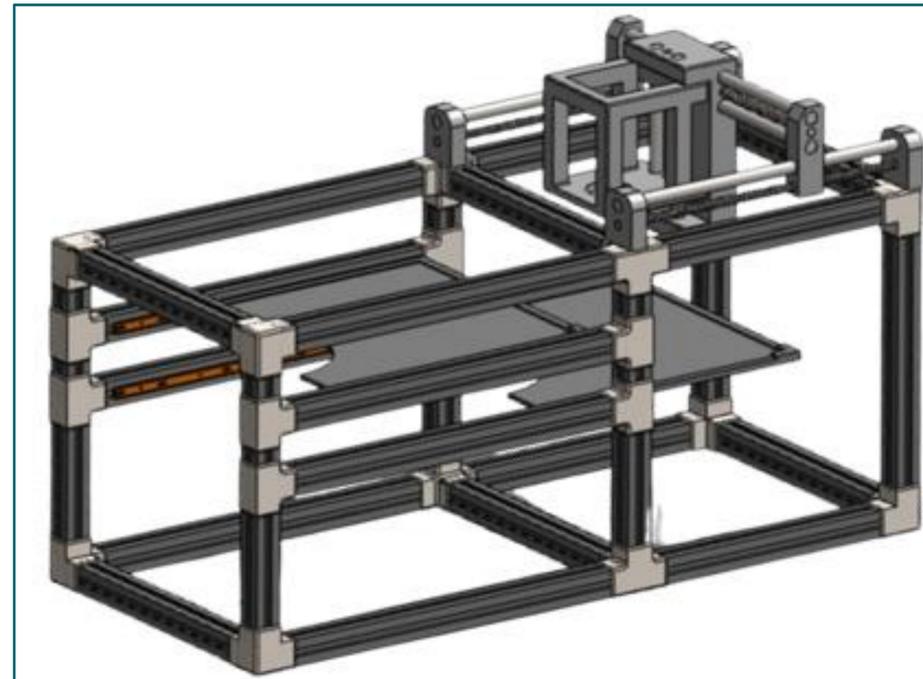
➤ Constraints

- Works with 220V/60Hz
- Web based monitoring with the laser app and communication between the cloud and should be (≤ 200 seconds)
- Tile weight should be (≤ 10 kg)
- Laser engraving machine has a spot size of $0.06\text{mm} * 0.06\text{mm}$

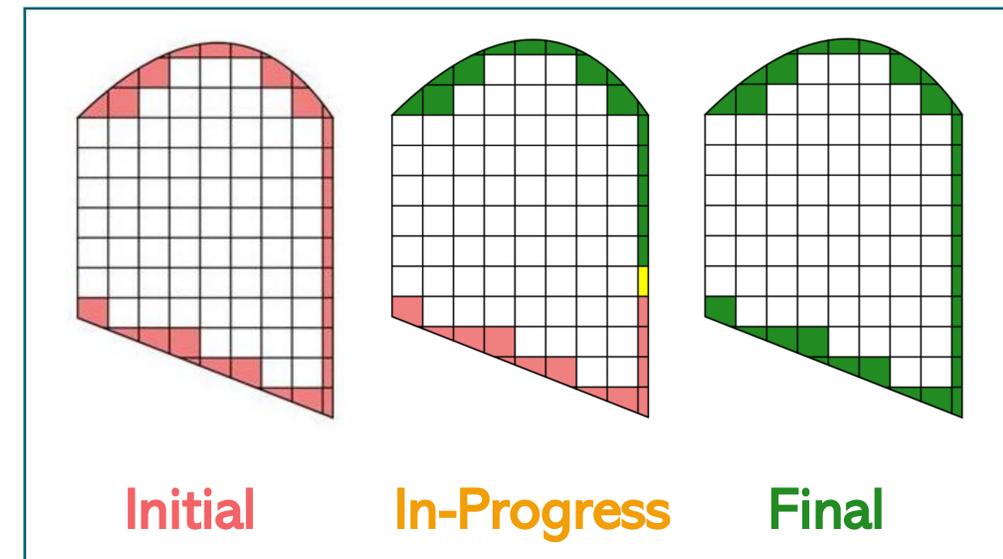
➤ Specifications

- Uses Arduino + CNC Shield V3 for motor and actuator control.
- Cloud functions run within 5 vCPUs, 9.9 GB RAM, and 5 GB storage.
- Supports porcelain tiles up to $30 \times 30 \times 1.2$ cm.
- Optimization model responds in (≤ 10 min).
- Tile marking completes in an average of 3 min.
- Uses OR model to minimize tile waste.
- Device setup takes (≤ 1 hour).
- Complies with Saudi laser safety regulations.

➤ Prototype Design



➤ Tile Engraving Visualization Software



➤ Project Impact

The project delivers an automated tile engraving system that combines a mathematical model with laser marking to improve accuracy, reduce waste, and speed up the tiling process. It offers a safer and more efficient alternative to manual methods, enhancing overall workflow in construction.

➤ Conclusions

This project successfully developed a smart tile marking system that integrates laser automation with optimization algorithms. The prototype achieved accurate tile estimation, automated cutting guidance, and real-time monitoring, demonstrating a functional and efficient solution for modern tiling tasks.