PROJECT ABSTRACT

# 3D Laser Scanner using Turntable

*A 3D laser scanner on a stepper-driven turntable: a red laser line sweeps the rotating object, a camera captures each profile, and triangulation software builds the 3D point cloud.*

## 01. Title

3D Laser Scanner using Turntable

## 02. Introduction / Background

3D scanning converts physical objects into digital models, and laser triangulation is the workhorse principle: project a laser line onto the object, observe from an angle how the line deforms over the surface, and geometry yields depth. Commercial scanners hide this chain; this project exposes it — a NEMA17-driven turntable, a red laser line module, a USB camera and Python processing, all built and calibrated by the student.

## 03. Problem Statement

Students learn about 3D scanning as a finished product, never seeing the triangulation, calibration and processing underneath. A buildable turntable scanner links mechanics, stepper control, optics and software into one project with a real measurement output — and forces an honest discussion of what determines accuracy: calibration, not marketing.

## 04. Objectives

- Build a stepper-driven turntable that indexes the object in fine, repeatable steps.
- Project a red laser line onto the object and capture each profile with a USB camera.
- Implement triangulation in Python (OpenCV) to convert stripe deformation into 3D coordinates.
- Provide a calibration procedure and export the result as a viewable point cloud.

## 05. Proposed Methodology

The object rotates on a wooden turntable driven by a NEMA17 stepper through a DRV8825, controlled by an Arduino that synchronizes rotation steps with PC capture. A red laser line module on an adjustable column throws a stripe across the object; the camera, fixed at a known angle, captures each profile. Python software extracts the stripe centerline per frame, applies the calibrated triangulation geometry, and assembles the point cloud. A one-time calibration with a known-geometry target fixes the camera–laser parameters.

## 06. System Architecture / Working

- Object on wooden turntable → NEMA17 + DRV8825 → Arduino step control
- Red laser line module on column → stripe projected onto object
- USB camera at fixed angle → captures stripe profile per step
- Python/OpenCV → stripe extraction → triangulation → point-cloud export

## 07. Hardware / Software Requirements

- NEMA17 stepper motor, DRV8825 driver, Arduino Uno
- Red laser line module, USB camera
- Wooden turntable, aluminium column, 3D-printed mounts
- Python with OpenCV; free point-cloud viewer software

## 08. Expected Outcomes

- A working scanner producing 3D point clouds of small matte objects (design target up to ~120 mm tall).
- Configurable step angle trading scan time against point density.
- A documented calibration procedure — the step that determines the ~1 mm-order design-target accuracy.
- Complete report, PPT and viva Q&A; on triangulation theory and calibration.

## 09. Applications

- Digitizing small objects (figurines, machined parts) for student CAD/modeling work.
- Teaching laser triangulation, camera calibration and point-cloud processing.
- Reverse-engineering exercises in mechanical-design coursework.

## 10. Future Scope

- Add a second laser/camera pair to capture occluded regions.
- Automate meshing of the point cloud into printable STL models.
- Motorize the laser column for multi-height scanning of taller objects.