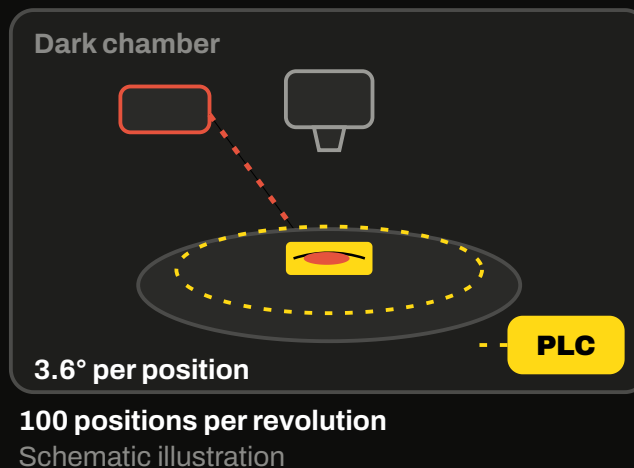


WOOD RESEARCH · M-DUINO 58

A laser shows the grain. **A PLC turns the wood.**

9,000 images per species, one 3.6° step at a time.

[Read the interactive case study online ›](#)**3.6°**

per position: 2 full steps of
a 200-step motor

1,800

images per wood sample

9,000

images per species

60

commercial timber species
from Malaysia

THE CHALLENGE

Thousands of images, each at an exact angle.

In the timber industry, the grain angle is key to judge the mechanical strength and the quality of wood. The project studied how well a laser method detects that angle in 60 commercial species from Malaysia. To do it with scientific rigour, the team needed a data acquisition system that is large, precise and automated.

01

Exact angles

The sample turns on a platform in steps of 3.6°. Every image must match a known angle. With a stepper motor and no position sensor, one lost step shifts every image after it.

02

A very large data set

1,800 images per sample and 9,000 per species. By our count, over 60 species that is 540,000 images. Too many to take by hand.

03

Long sessions in the dark

The laser, the camera and the sample sit in a dark chamber. The test sessions are long, and the capture must not stop in the middle of a sample.

04

Own software in the loop

The team wrote its own image capture software in Visual Basic. The controller has to take orders from that software and answer it.

The result



With the automated data, the study concluded that the colour and the density of the wood directly influence how well the laser method detects the grain angle. The data also trained machine learning models (such as k-NN and artificial neural networks) that predict the detection performance with an accuracy of up to 89.3%.

HOW IT WORKS

Three jobs: step the platform, talk to the software, fill the data set.

Job 1 · Step the platform

Two steps, 3.6°, then stop.

A 200-step motor moves 1.8° per full step. Two full steps give 3.6°, so one revolution has 100 positions. The PLC sends the step pulses to a stepper driver, and the driver powers the motor coils. Advance one position, or run a full revolution.

Job 2 · Talk to the software

Move, confirm, capture, save.

The capture software runs on a PC. It asked the PLC to advance the platform, took the image and saved it automatically. The project does not publish the messages. A typical way to do it: the PC sends a short command, the PLC moves and answers when the platform stands still, and only then the PC takes the image. Run the cycle, then lose an answer.

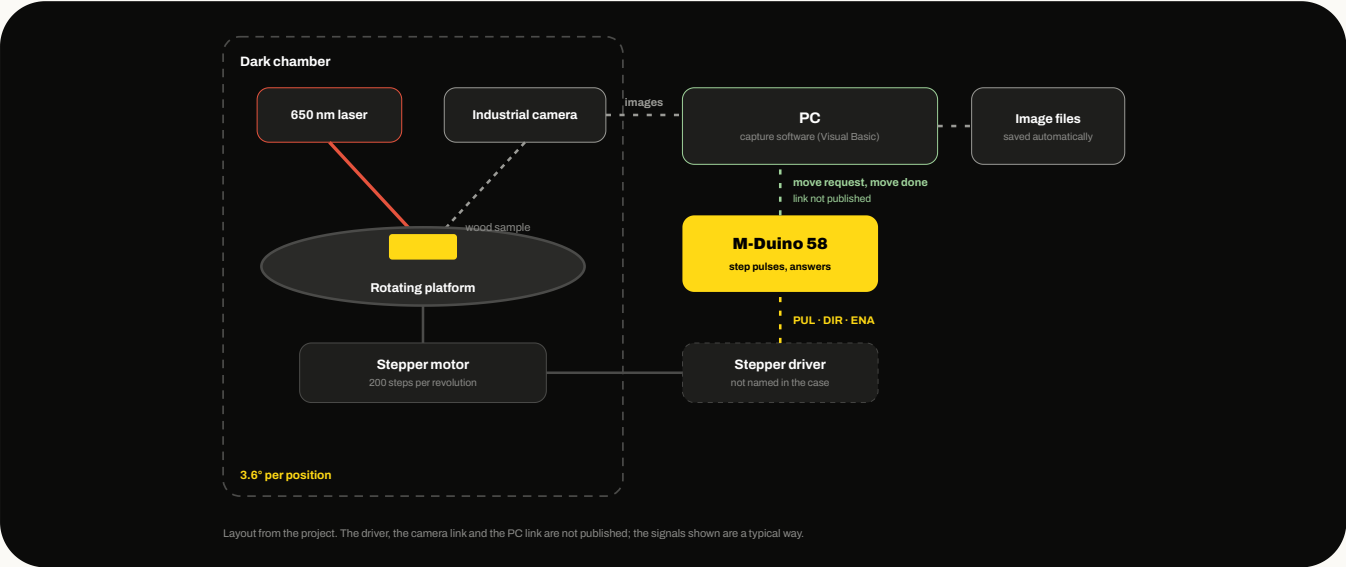
Job 3 · Fill the data set

From one step to 540,000 images.

The project took three revolutions per position and six random sampling points, for 1,800 images per sample and 9,000 per species. By our reading, that is 6 points per sample and 5 samples per species. Change the step angle, the revolutions or the time per image, and see the size of the data set and the run time.

How do you take laser images of wood at exact angles?

Put the sample on a rotating platform in a dark chamber, under a 650 nm laser and an industrial camera. Turn the platform with a 200-step stepper motor and a stepper driver, and let a PLC send the steps. In this project an M-Duino 58 moved the platform in steps of 3.6°. Custom software on a PC asked for each move, took the image and saved it. The project does not name the driver, the camera or the link between the PC and the PLC.



Signals and data

Signal	Between	Type	Purpose
Move request	Capture software → M-Duino 58	Message (link not published)	Asks for the next 3.6° position
Step pulses	M-Duino 58 → stepper driver	Digital output, PUL (typical)	2 full steps per position
Direction	M-Duino 58 → stepper driver	Digital output, DIR (typical)	Sets the direction of rotation
Enable	M-Duino 58 → stepper driver	Digital output, ENA (typical)	Enables the driver, so the motor holds its position (polarity depends on the driver)
Motor current	Stepper driver → motor	Coil phases A and B	200 steps per revolution
Move done	M-Duino 58 → capture software	Answer (typical)	The image is taken only when the platform stands still
Laser light	650 nm laser → sample	Light	The spot stretches along the fibres (tracheid effect)
Image	Industrial camera → PC	Camera link (not published)	1,800 images per sample
Files	Capture software → disk	Image files	Saved automatically for the analysis

The PLC of the project.



M-DUINO ETHERNET PLC ARDUINO 58

The project used an M-Duino 58. It sent the step pulses for the 200-step motor of the platform and took the orders of the capture software.

Role in this project	Turns the platform in 3.6° moves and answers the capture software
Microcontroller	Arduino Mega 2560 (ATmega2560, 16 MHz)
Inputs	36: 16 analog/digital (0-10 V, 10-bit) and 20 digital optoisolated, 5 to 24 Vdc, 6 with interrupt
Outputs	22: 8 analog/digital/PWM (0-10 V, 8-bit) and 14 digital optoisolated, 5 to 24 Vdc
Communications	USB 2.0 Type-B, Ethernet (W5500, 10/100), RS-485, RS-232, TTL, I2C, SPI
Power and mounting	12 to 24 Vdc, DIN rail TS35, IP20, 0 to 60 °C; real-time clock and microSD slot

The project does not publish the stepper driver, the camera or the link between the PC and the PLC. A stepper motor always needs a driver between the PLC and the coils. Our [stepper motor tutorial](#) shows the wiring, with PUL, DIR and ENA on digital outputs. Check that the output voltage matches the inputs of your driver.

[See the M-Duino 58 ›](#)

Logic that follows the study

The stepper control and the link with the rest of the system were programmed to fit the experiment, including 3 revolutions per position and 6 random sampling points. The PLC is programmed in the Arduino IDE.

Industrial hardware in the lab

The PLC is built for a cabinet: DIN rail, 12 to 24 Vdc supply, optoisolated digital I/O. The project reports that the capture was not interrupted during the long sessions over the 60 species.

Room to grow

The M-Duino 58 has 36 inputs and 22 outputs, and a rig like this one uses only a few. A home sensor for the platform, a laser enable or a second axis can go on the same PLC.

BUILDING A TEST RIG OR A LAB INSTRUMENT?

**Tell us what moves and what you measure.
An engineer will answer.**

Tell us what the rig must move, how precise each step must be, what takes the measurement and which software runs it. We will propose the PLC, the motor driver and the link to your software.

READ IT ONLINE

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