

Bench Top UTM Machine

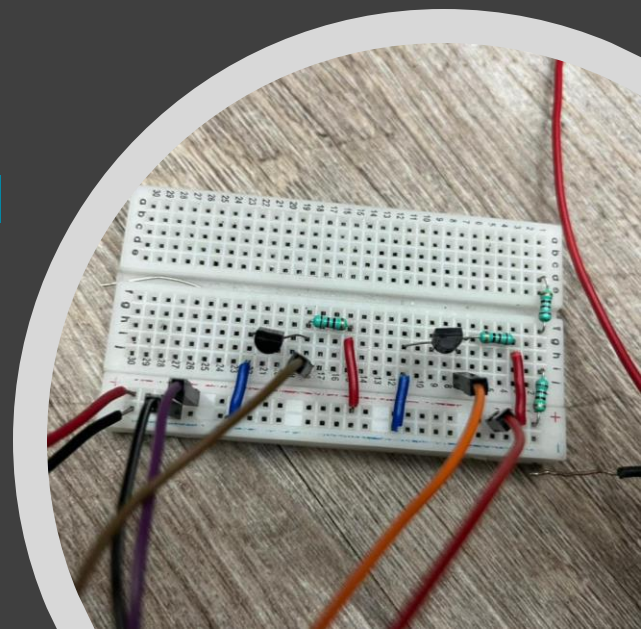
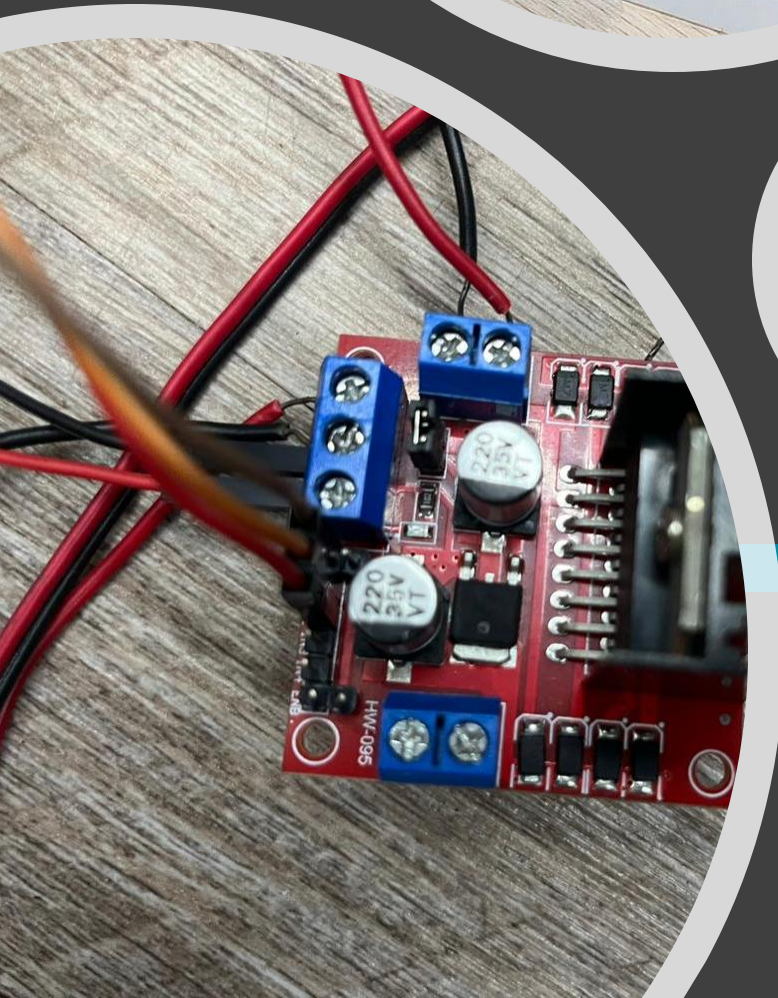
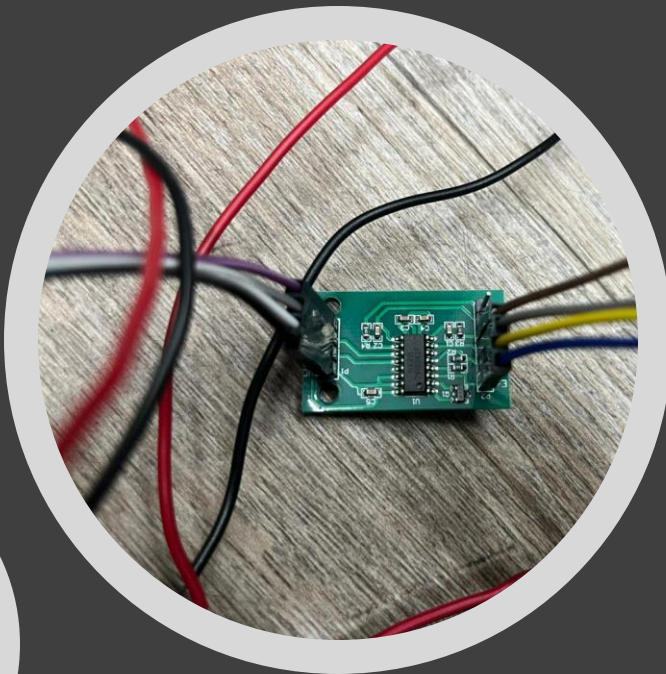
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ABOUT UTM

The benchtop Universal Testing Machine (UTM) comprises a worm gear DC motor driving the movement of crossheads via a lead screw and two steel rods, enabling precise control of vertical motion. Employing an S-shaped load cell, the UTM measures mechanical forces applied to metallic wire specimens during tension tests. This setup facilitates the determination of tensile strength and other material properties critical for quality control and product development in various industries, such as manufacturing, aerospace, and automotive.

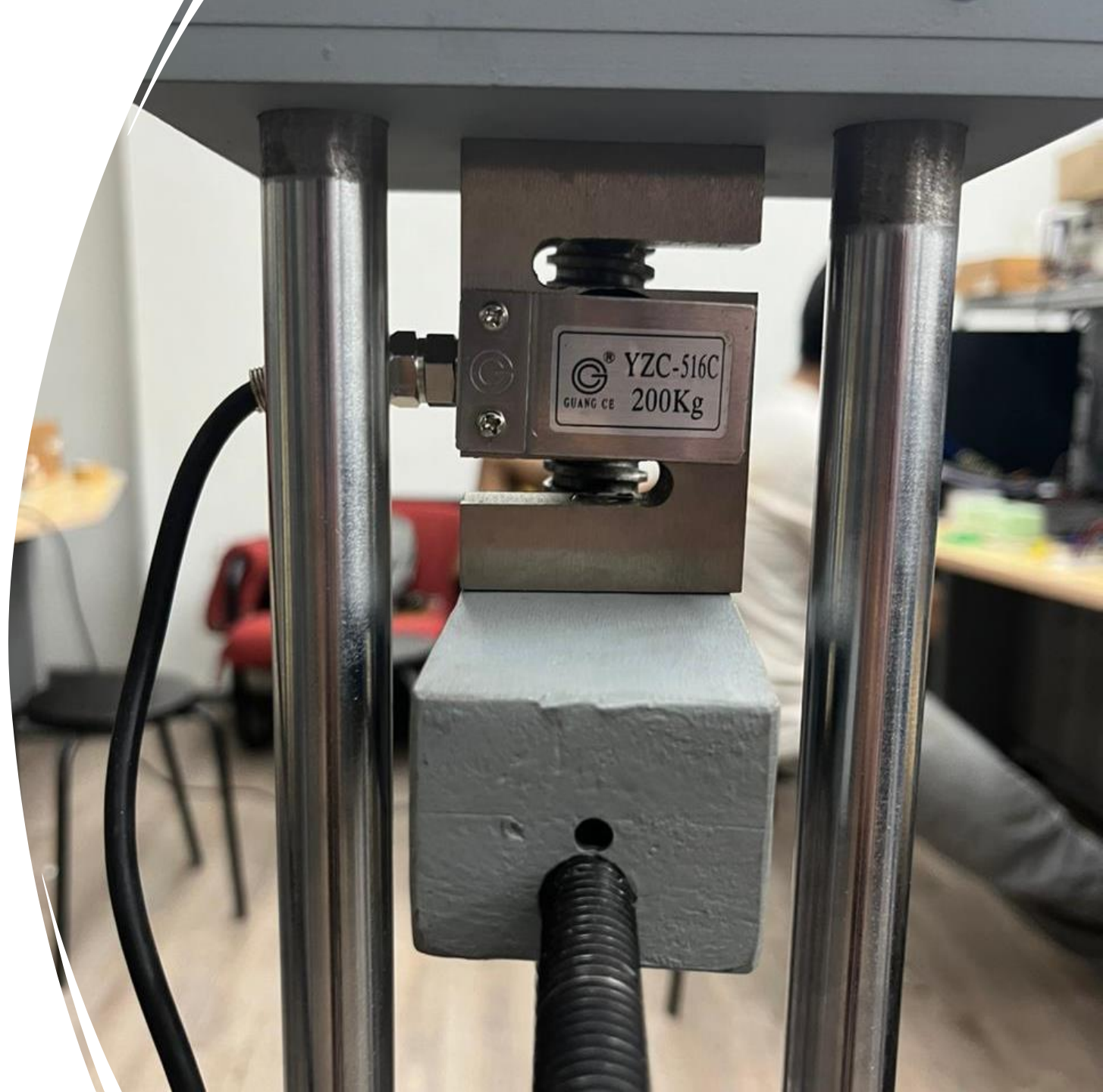




Components Used

S-shaped Load Cell Rated 2kN

The load cell is responsible for accurately measuring applied force during mechanical tests. It converts mechanical force into electrical signals, providing real-time feedback for precise testing



Digital Dial Gauge Indicator

The Dial Gauge provides precise measurements of the crosshead displacement. After identifying the clock and data pins, we interfaced the Dial Gauge with the Arduino board. This enabled real-time monitoring of the crosshead position, allowing for accurate data acquisition during testing. By receiving signals from the Dial Gauge, the Arduino translates them into actionable data, facilitating precise control and measurement in our testing procedures



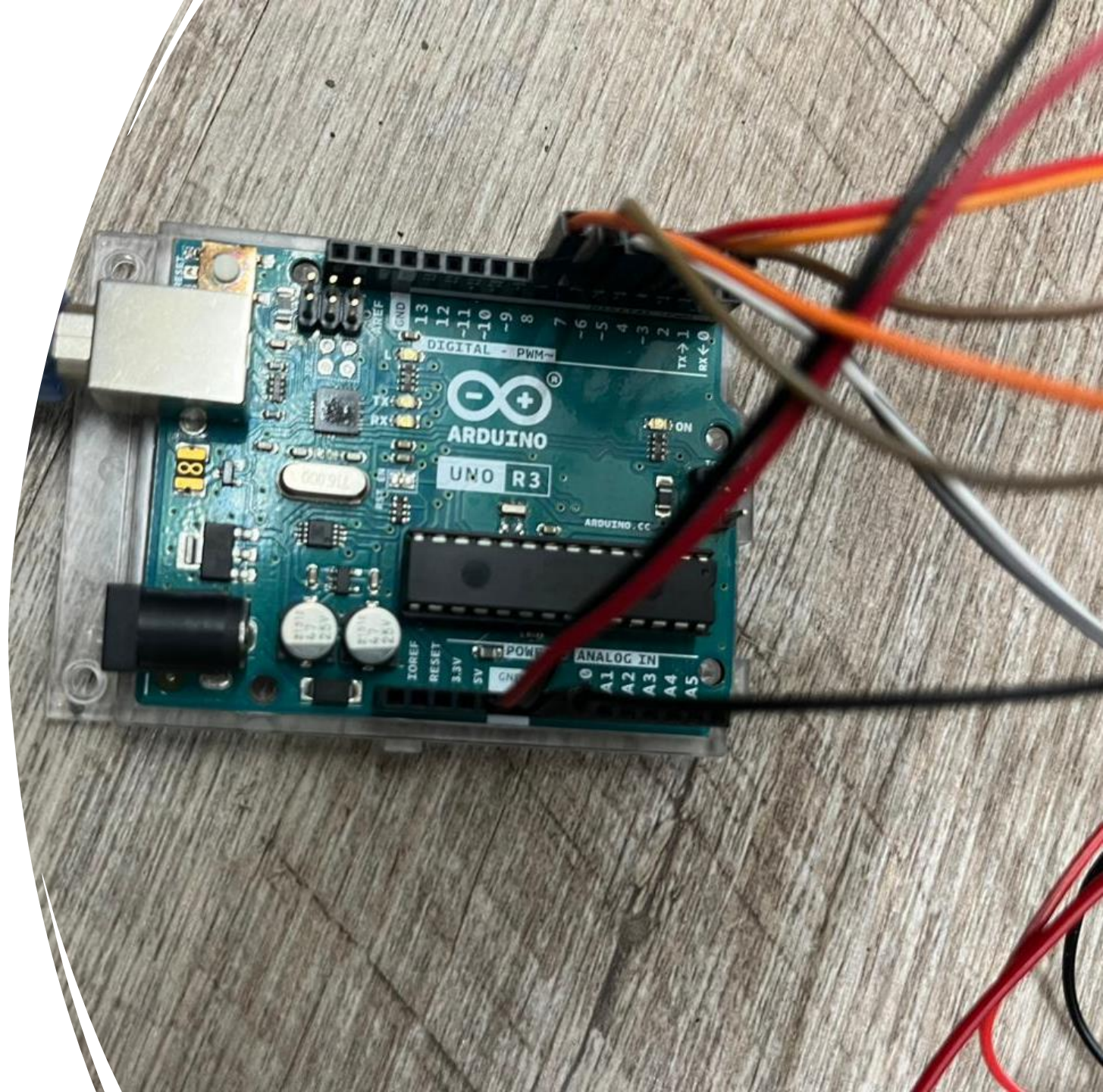
Worm Gear Motor Rated 12V, 4A

The worm gear motor in our Benchtop UTM setup drives the lead screw rotation, exerting high torque to break test specimens. It operates efficiently, translating rotational motion into linear displacement of the crosshead with precision



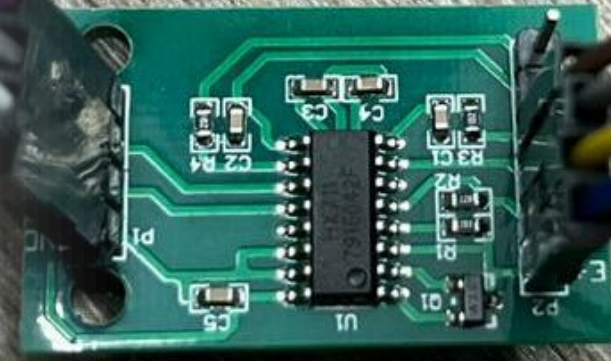
Arduino UNO

Main microcontroller which is receiving data points from the different sensors and is coded to give the calibrated desired data



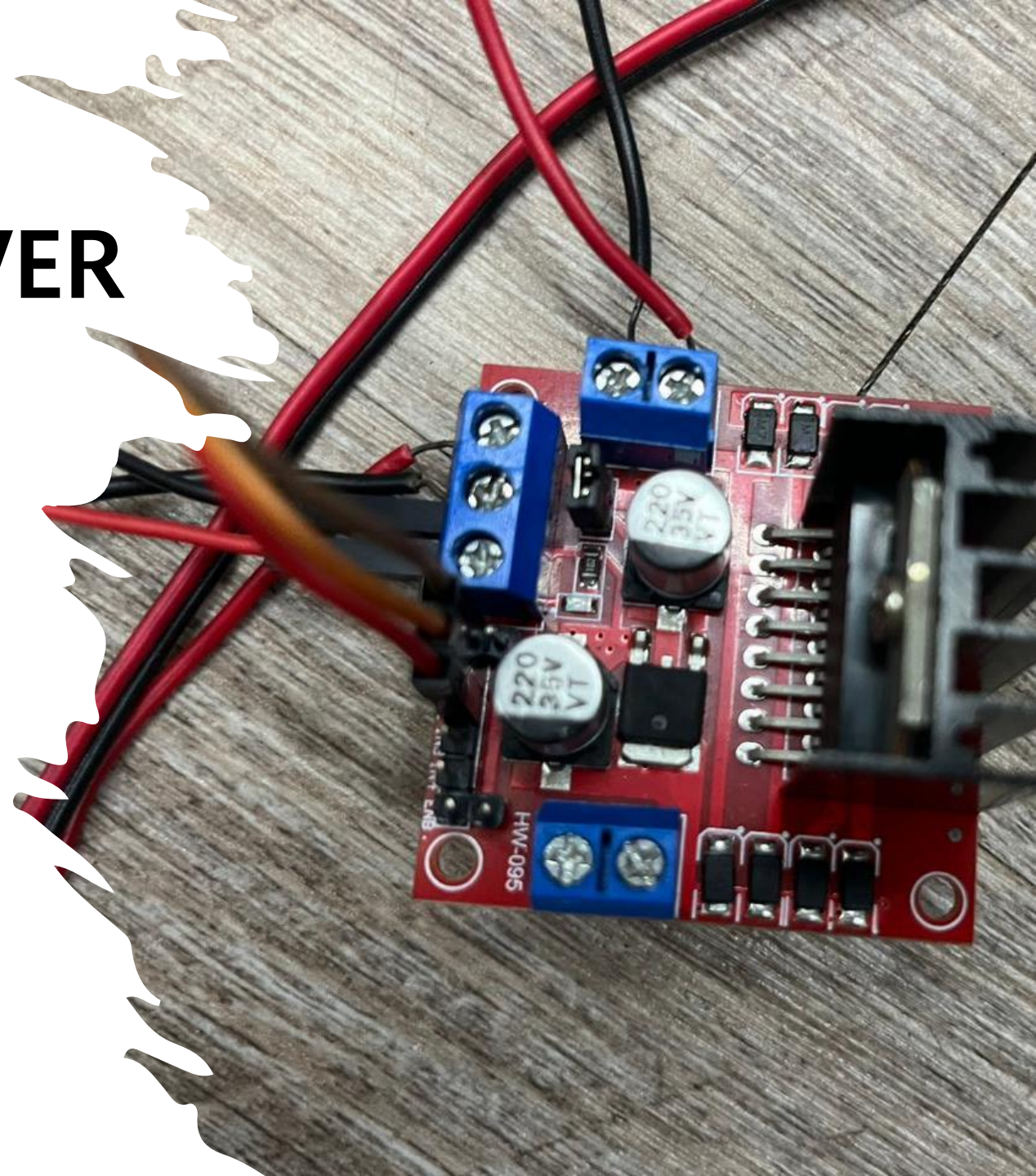
Hx711 – Analog to Digital Converter (ADC)

This was the amplifier we used to get amplified output data from the loadcell which was fed into the Arduino. And then we calibrated the output data to get desired stress



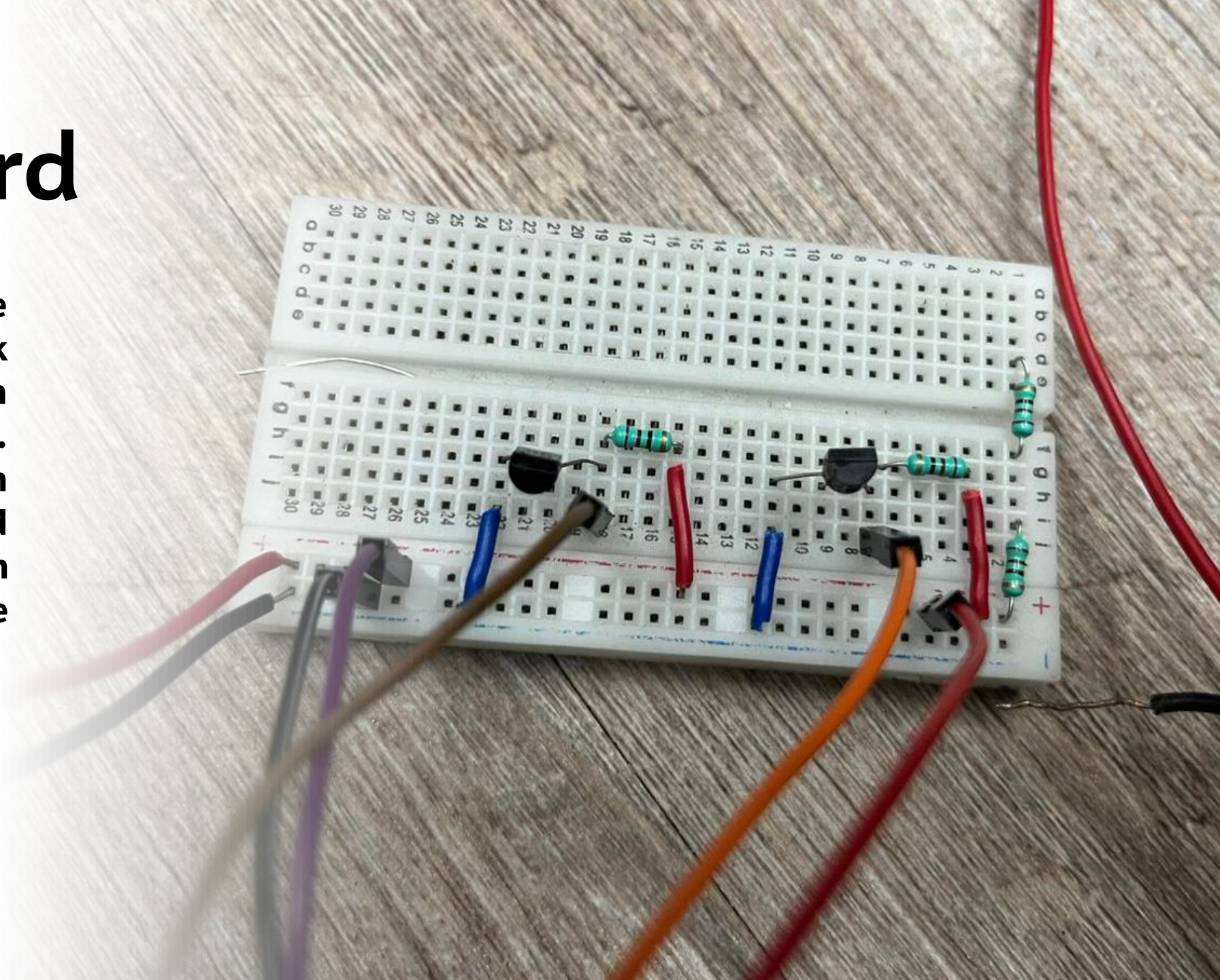
L298N MOTOR DRIVER

The L298N motor driver is a versatile motor control module used in our Benchtop Universal Testing Machine (UTM) to drive the worm gear motor. It enables precise control over the motor's direction, speed, and torque. By interfacing with the UTM's microcontroller unit, the L298N facilitates accurate positioning and movement control, crucial for conducting mechanical tests on materials



Circuit Board

This circuit is to amplify the output from data and clock pins. There are four 220 ohm resistors and two transistors. Two resistors are utilized in the circuit of the amplifier and two resistors are involve in controlling the current to the Dial Guage



Toggle Switch

The toggle switch helps in our Benchtop UTM setup to enable control over the lead screw's direction. We used it to toggle between clockwise and counterclockwise rotation of lead screw, facilitating smooth up and down movement of the crosshead



Working of this UTM machine

The machine is controlled dually. One by the microcontroller and one by us manually. We have a toggle switch which we can use to move the crosshead up and down for the desired distance between them to fix the specimen. After that the control is shifted to the microcontroller. It moves the crosshead downwards thus applying tensile load on the specimen. And at the same a real time data fetching algorithm gives us the stress and strain data. This is then used to plot a real time graph of stress vs strain which can be used to interpolate the Young's modulus of the specimen.

A short demonstration of this project is present in this link (you can hear breaking sound of wire) :

<https://drive.google.com/file/d/1Xrs5pwz2RWlyWjlcoCjUCHUvxSGCnCDg/view?usp=sharing>

PROBLEMS FACED

FABRICATION

Machining the lead screws and crossheads along with accurate holes and position of grips

DIAL GAUGE INTERFACING

Dial Gauge interfacing with Arduino UNO to get desired outputs in serial monitor

HIGHER RANGE IN DIAL GAUGE

Attaining a higher range of strain than the specified range of dial gauge i.e. 0 to 5mm

CODE

Writing Arduino codes for proper integration of software and hardware like motor driver, electronic circuit, etc

SPECIMEN MATERIAL

Considering a wide range of metallic wire specimens with different shape, size, etc

MOTOR FAILURE

Last minute motor failure due to shorting of inner coils

SOLUTION

FABRICATION

Developed few 3D CAD designs with actual dimensions that will be used for machining the actual prototype. Revised the design 2 to 3 times to conclude the final structure

DIAL GAUGE INTERFACING

Identified the clock and data pins then amplified the output using transistor 2N2222 and configured real values using Arduino

HIGHER RANGE IN DIAL GAUGE

Used Rack & Pinion kind of linear to linear gear arrangement to increase the range of Dial Gauge to 3 times its original

CODE

Regressive trials and error and after a lot of efforts we matched different conversion rate of both dial gauge and load cell

SPECIMEN MATERIAL

Designed with the help and input of investment experts in the field

MOTOR FAILURE

Exchanged the worm gear motor with a new one

Thank You!

- For more details, Click this link below to open my github repository.

- Github Repo:
<https://github.com/HimanshuR321/Bench-Top-UTM-Machine>

