TEST SETUP FABRICATION
Micro-Tensile Testing Machine

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I. INTRODUCTION

The utility of a micro-tensile testing machine is that for a convention tensile testing process, the sample required has to be of a specific standard geometry and a specific size. For materials like carbon fibre, hair fibre or cloth fibre, it is difficult to test for tensile strength and related properties like yield strength, Young's modulus, ultimate tensile strength and fracture point in this manner. They necessitate a smaller test setup so that their properties can be measured accurately. Also, specimens which are available in smaller sizes require such a setup. Hence, this project is an attempt to fabricate such a machine.

II. DESIGN AND WORKING

Our machine is a horizontal setup that consists of a base plate, two vertical plates that support the S-type load cell and the NEMA-17 4.2 kg-cm Stepper motor. The linear actuator consists of a lead screw which is driven by the motor and moves the specimen holder which is supported by ball bearings and guide grooves on the base plate. Plugs are attached to the specimen holder and the load cell to hold the specimen.
Table I gives the specifications of the parts used.
Figure 1 and 2 show respectively the 2-D and 3-D design of the micro-tensile-testing machine. The arduino controls the rotation of the stepper motor. This rate is maintained to be a constant. Hence, the lead screw rotates at a constant rate. This ensures that the linear movement of the specimen holder is controlled and is at a constant velocity. This causes the extension of the specimen at a uniform rate and hence, the strain rate is constant. On the other hand, the load cell measures the tensile force that the specimen develops and gives the readings to the arduino. A table is plotted between time, displacement and force values which will be used for further computations.
Our machine is set for a specimen length of 8cm and it can impart a force of 200N, considering frictional losses and other aspects of the motor capabilities. The maximum extension that can be measured by our machine is 50%.

TABLE I. Part list

Sl. no.	Part	Specification
1	Stepper Motor	NEMA 17 4.2 kg-cm, 1.8$\circ$ Step-angle
2	Load Cell	S-type, 0-200 kgf
3	Ball Bearings	10mm inner dia., 26mm outer dia., 8mm thickness
4	Coupling	5mm to 8mm, SS
5	Lead Screw	M8, 1mm lead, SS
6	Body	MS plates, square shafts
7	Specimen Holder (Nutbox)	Alumnium
8	Screws	M6, M3

III. DISCUSSION

The setup we attempted to fabricate is an unconventional one as compared to the conventional support rod mechanism used in micro-tensile testing machines. We made an aluminium specimen holder (nutbox) that houses the plugs that hold the specimen. Due to this design, the machining time required was more than what the conventional design requires.

IV. CONCLUSION

This project provided us a learning experience of how a machine is designed and fabricated for engineering applications.

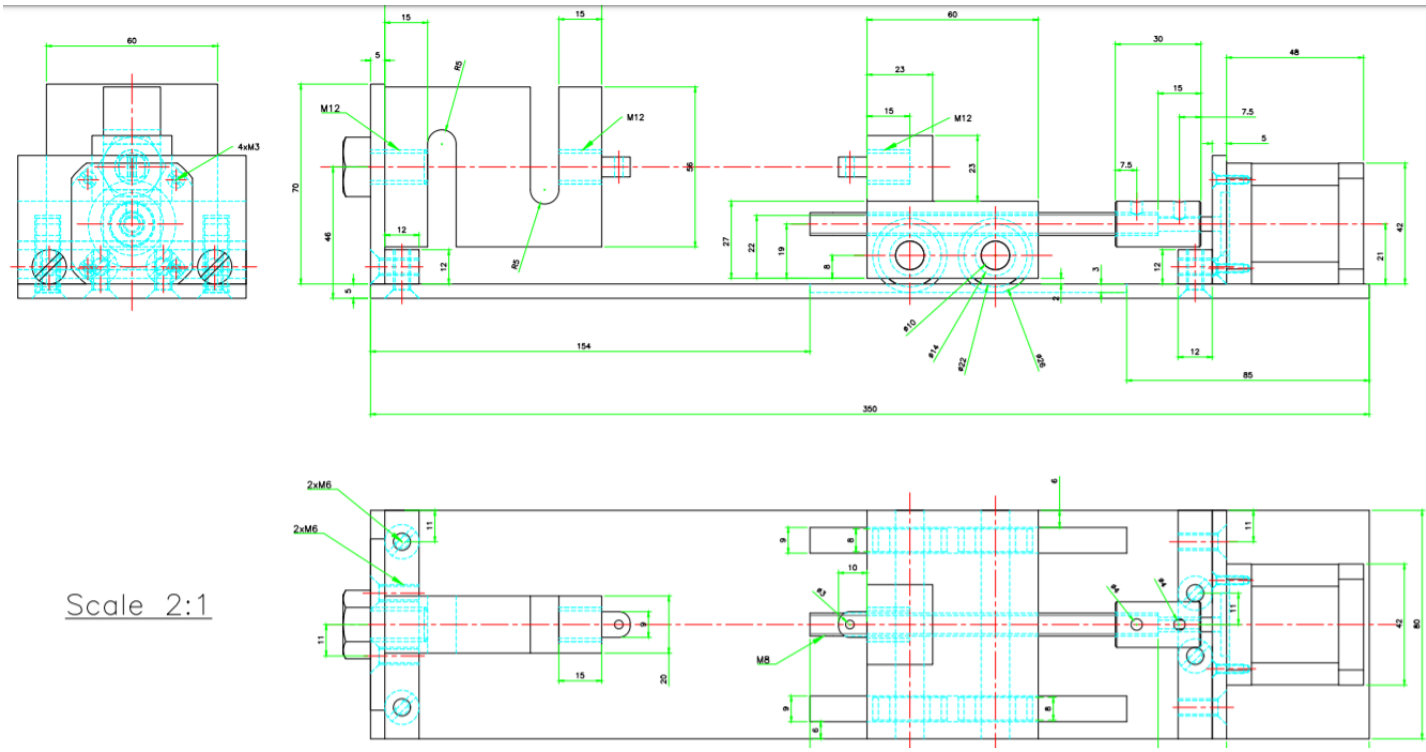

FIG. 1. 2-D design of the machine

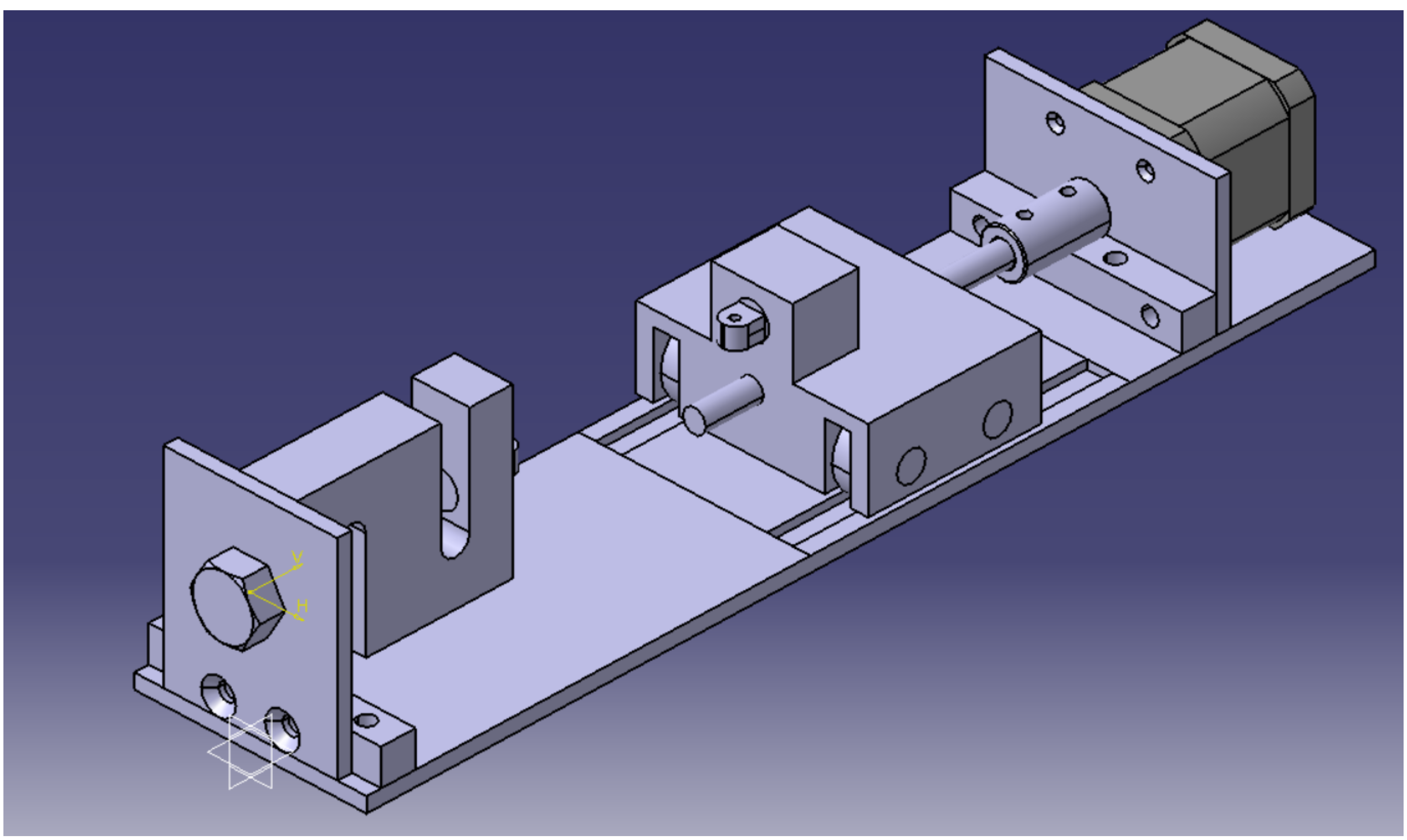

FIG. 2. 3-D design of the machine