Plasticity Modeling

ME486C

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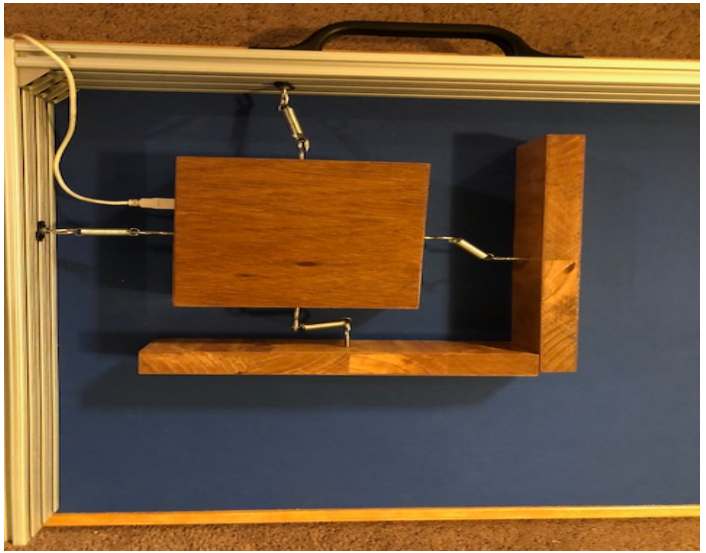
Introduction

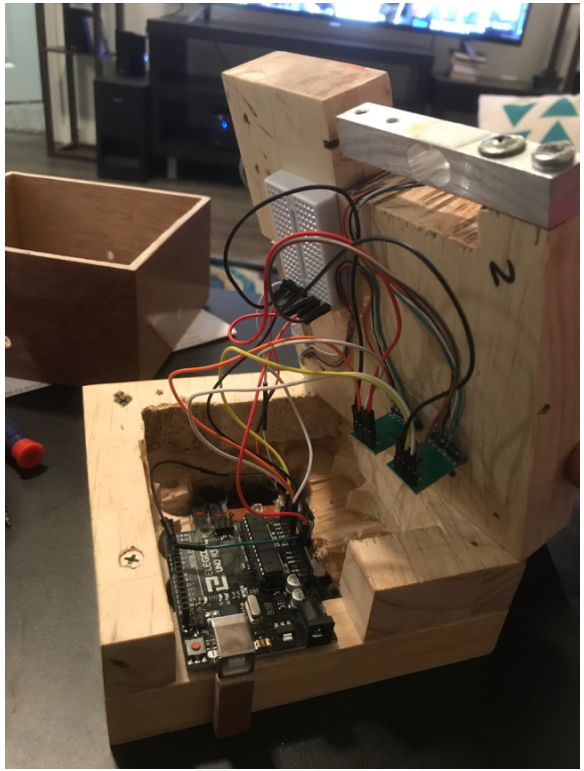
- Our project is to design an experimental device that would help measure the force Vs. displacement applied to a block.
- The block will be attached to a springs connected to the surrounding walls, which will act as resistors to the force applied.
- A USB connection from the Arduino to the laptop device to illustrate the digital data and generate the graphs.



Mutairan Alhabashi

Customer Requirements

1. Desktop sized system
2. Large to seen in the classroom of 20 students
3. Small to store in an office
4. System will controlled by the user
5. Work in both tension and compression
6. Light weight
7. Plotting force vs. displacement
8. Multiple frictional surfaces



Mutairan Alhabashi

Engineering Requirements

1. Max Spring Expansions
2. Pushing Pulling Force
3. Frictional Factors
4. Weight of system
5. Length of Sliding Area
6. Wireless Control distance
7. Weight of Sliding Box
8. X Y direction displacement
9. Durability
10. Reliability

Targeted Tolerances

1. 0.15 m
2. 5 Kg
3. 1
4. 18 Kg
5. 0.5 m
6. 1 m
7. 2 Kg
8. 0.25 m in the X; 0.25 m in the Y
9. 10 years
10. 90% success rate.

Abdullah Almutairi

Design Solution

The team worked very hard to ensure that the project has met both the Customer and Engineering requirements.

Choosing:

- Electronic weight sensors.
- HX711 Amplifier.
- Optical PS2 mouse.

Improvements:

- Rubber Sheet.
- Handles.
- Pulling Blocks.

Manufacturing

It took the team 2 weeks to finish manufacturing the device, and 3 weeks to program.

Materials used:

Fixed walls - 8/20 Aluminum

Base - Wood

Bottom layer - Rubber

Inner/Outer block - Wood

Handles - Plastic

Electrical components:

Arduino Uno

PS2 Optical Mouse

Load Cell Amplifiers (HX711)

Weight sensors

Breadboard

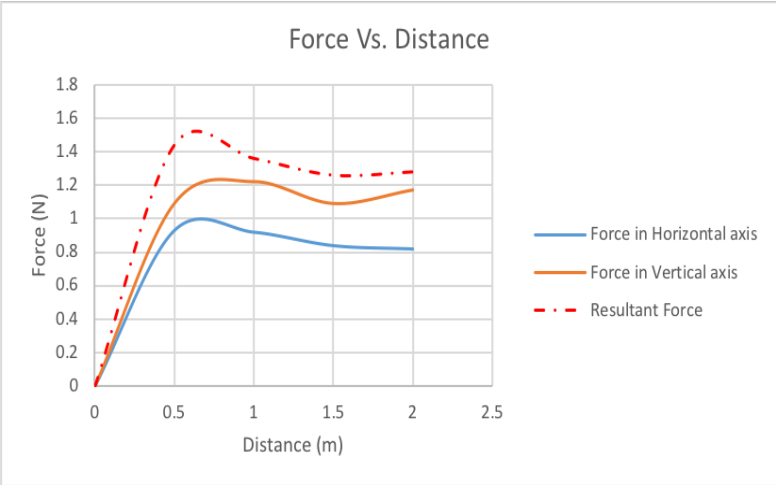
Wires

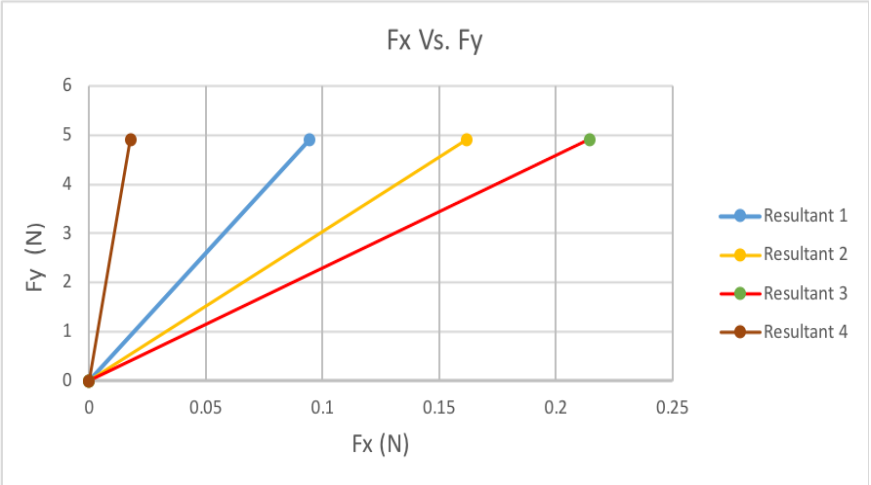
Omar Almutairi

Testing the final project

Testing Procedures:

- Test and calibrate the weight sensors. Using a scale, and a known weighted object.
- Measure displacement using a ruler and comparing it to the data.





Omar Almutairi

How to start out the program?

- Windows required.
- PLX-DAQ program.
- Run code on Arduino program.
- Select Port, then press the connect button.
- Graphs generated simultaneously.

Control The Design

- 2 load cell sensor used to read the forces in X & Y coordinates.
- PS/2 mouse placed at the bottom of the box and will be used to determine X & Y distances.
- Arduino that will be gathering the both sensors and have a digital data for each values.
- PLX-DAQ will have a column for each Fx, Fy, X distance, and Y distance.

Appendix A: will show the idea of how the Arduino are going to read the sensors.

Meeting the requirements

Weight of the device is ⟶ 10.4 Kg

Weight sensor can handle up to ⟶ 5 kg of force.

Achieved friction by adding ⟶ polythene as a surface.

Desktop size system ⟶ Squared shape.

Work in both tension & compression ⟶ Using of springs.

Handles were added to both Aluminum side ⟶ Portable.

Reading the distance at the same time for both axises ⟶ Optical PS/2 mouse.

Experience gained during working on this project

Each one of the team member has learned something new from this project and in general here to conclude with.

- This project has reflect important things in Physics & mechanics of material field.
- As the box move the output graphs should grow simultaneously, and when release the spring it will go back to zero.
- The negative sign where are getting when apply a compression force, that's due to the Hook's law
- The magnitude of graph change, whenever switch between the springs, and that because the material elasticity change.
- When the spring extend to it's limit, it will deform immediately, and that cause the error in the graphs.

Nawaf Alkhalaf

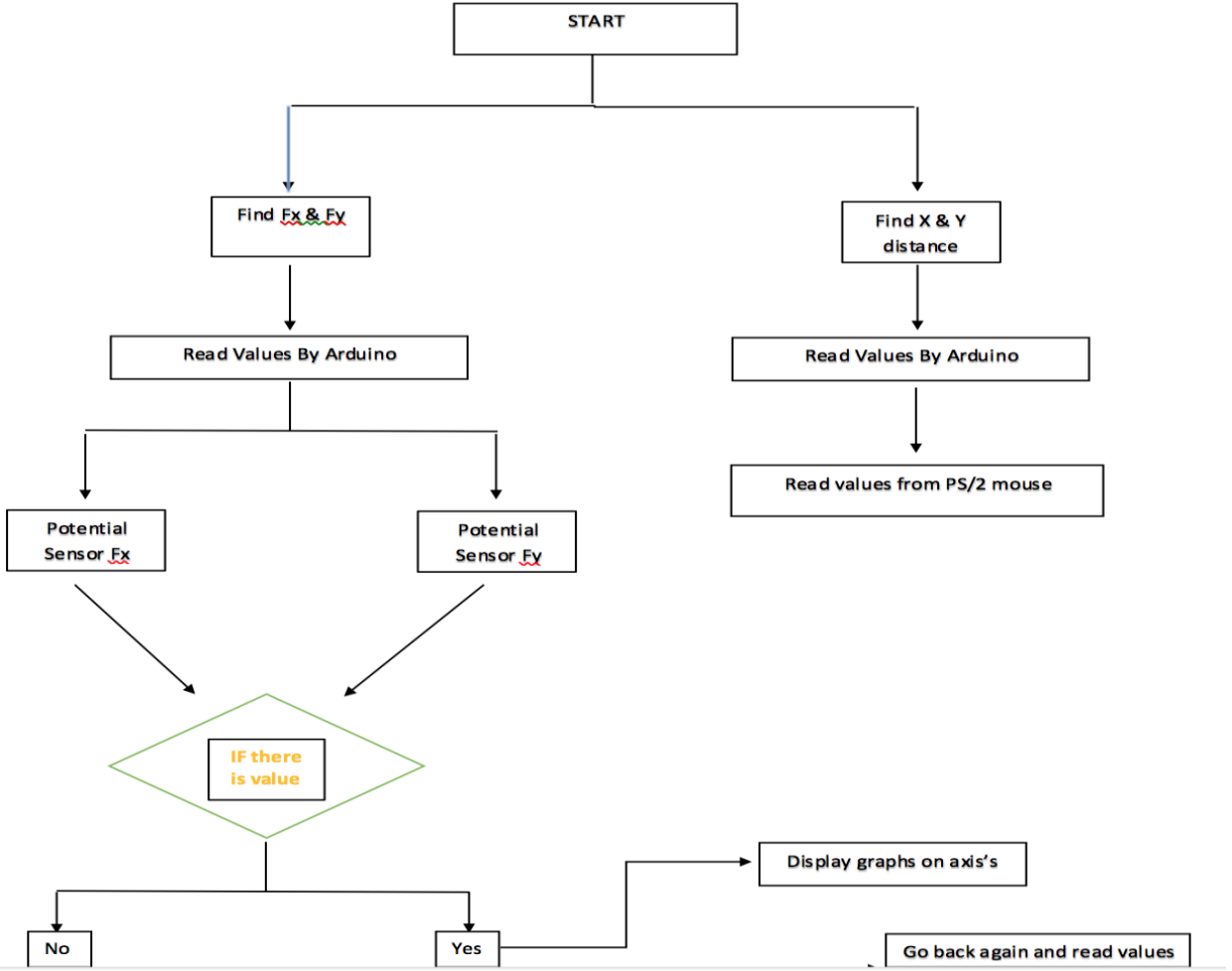
References

[1] Anon, (2018). [online] Available at: https://playground.arduino.cc/ComponentLib/Ps2mouse [Accessed 27 Apr. 2018].

[2] author:, M. (2018). *How to Interface With 5kg Balance Module or Load Cell*. [online] Instructables.com. Available at: https://www.google.com/amp/www.instructables.com/id/How-to-Interface-With-5kg-Balance-Module-or-Load-C/%3famp_page=true [Accessed 27 Apr. 2018].

Appendices

- **Appendix A: Flow chart**



Questions

Thanks for your patience and listening...

Any questions or concern?