Fernando Perez’s Portfolio

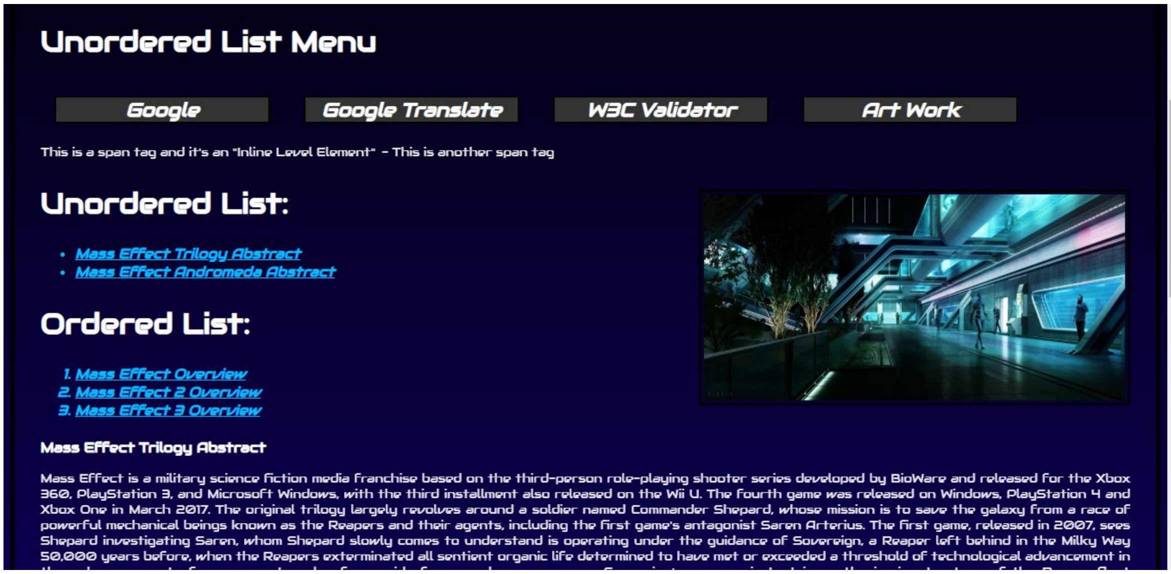
Index

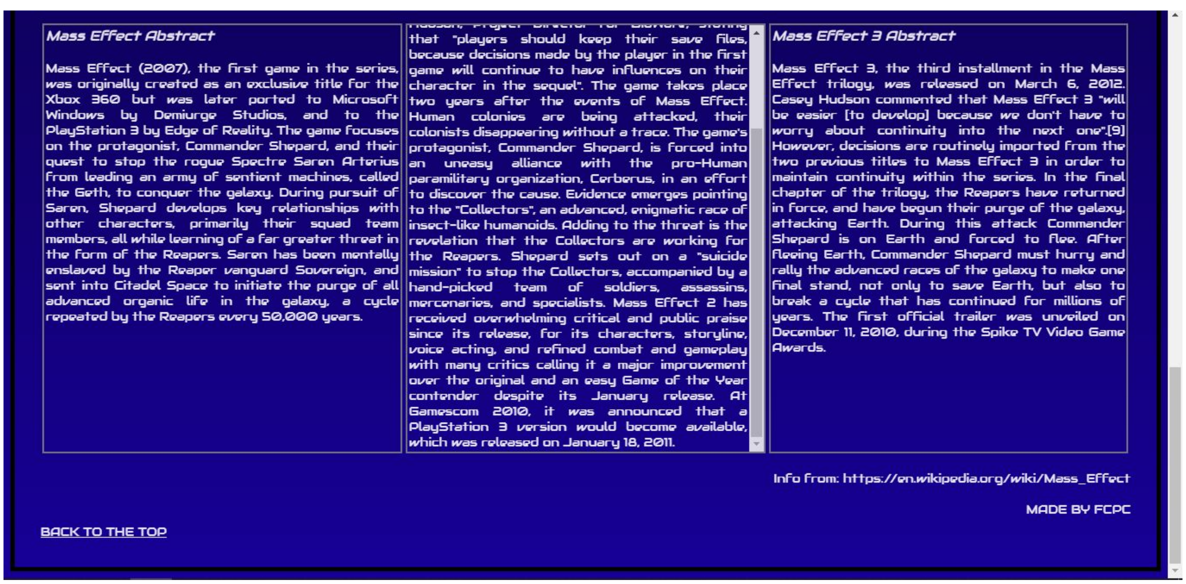
Web development

HTML5 and CSS3 personal test page with random content:

The purpose of this Web page was to apply HTML5 and CSS3 concepts.

Link: https://fernandof117.github.io/coursera_test/site/Main.html



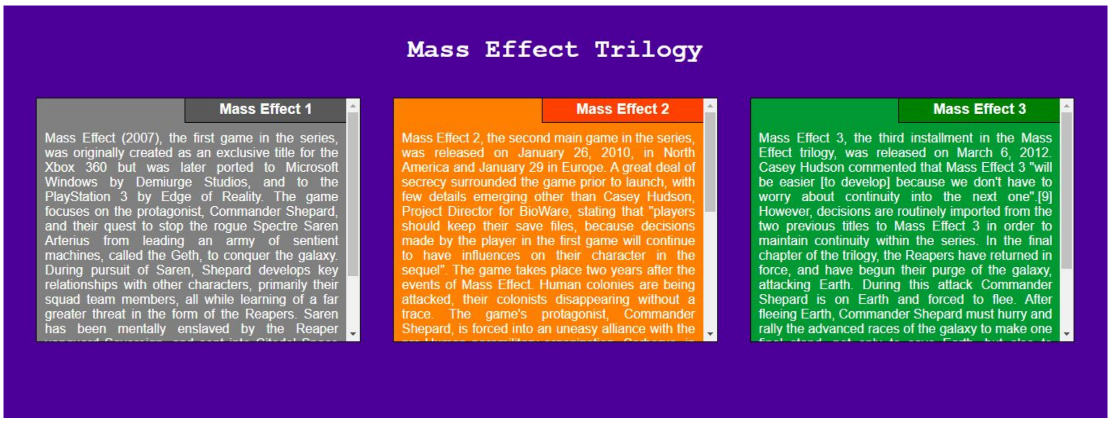


HTML5, CSS3 and Javascript specialization Course Assignment 2:

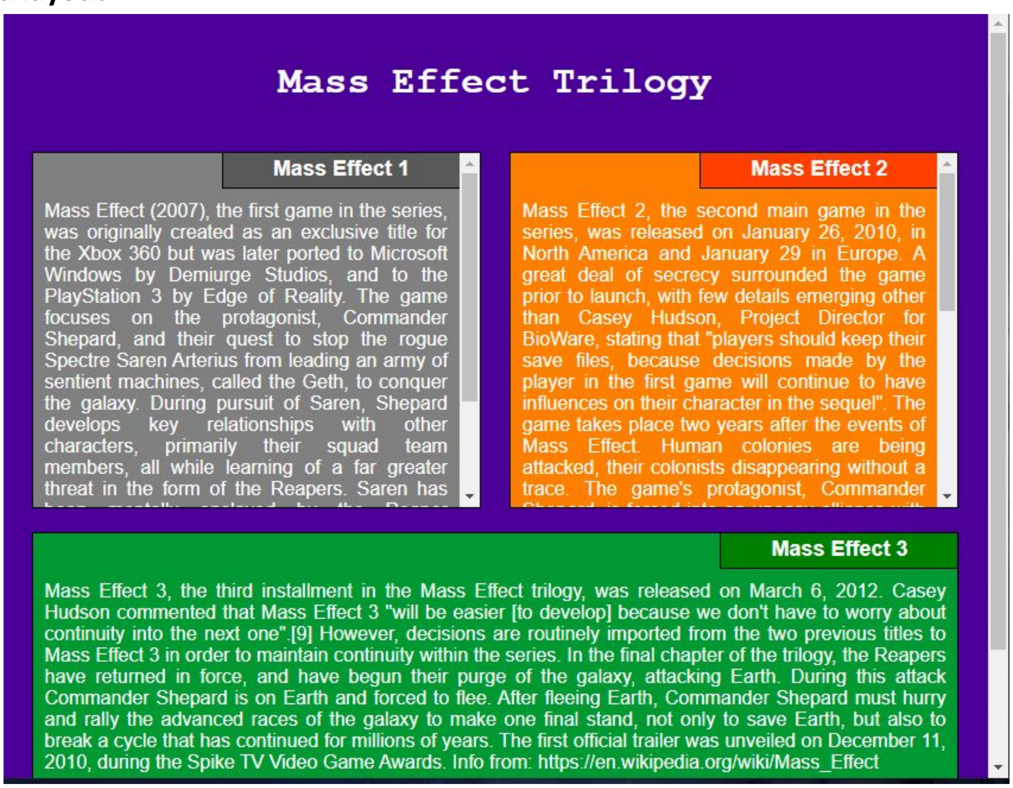
The purpose of this web page was to apply the learned concepts of HTML and CSS3 with responsive design (for different screen sizes). The text inside the page is random text.

Link: https://fernandof117.github.io/coursera_test/module2-solution/index.html

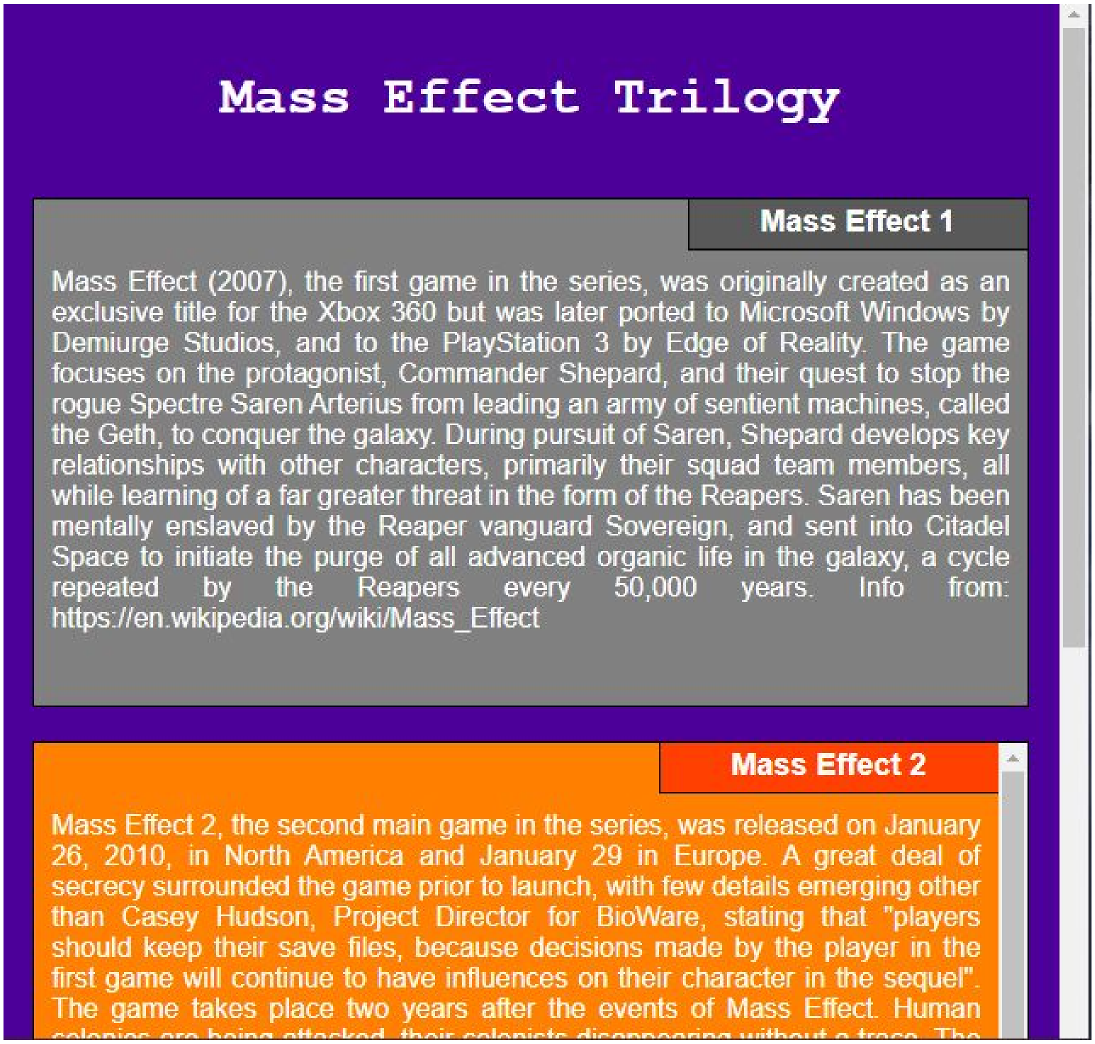
First layout



Second layout



Third layout



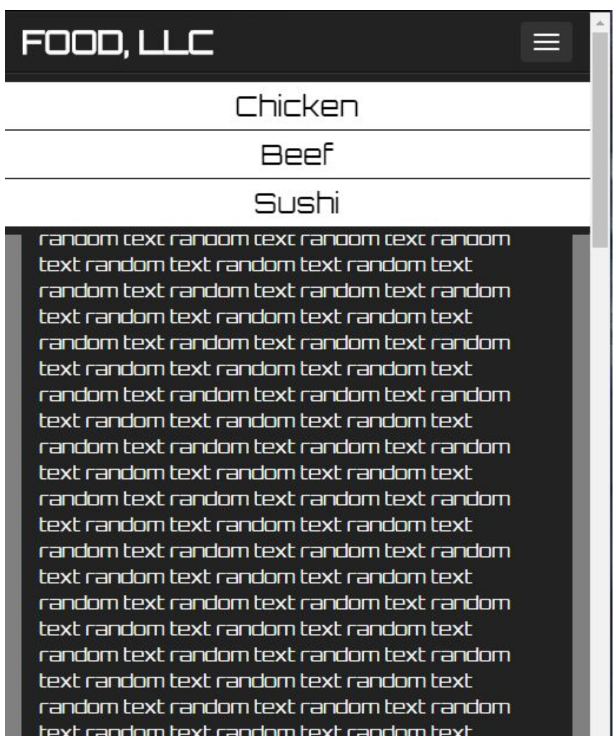
HTML5, CSS3 and Javascript specialization Course Assignment 3:

In this assignment I had to develop the shown page using a CSS3 Bootstrap framework with responsive design (different layouts of the page for different screen sizes).

Link: https://fernandof117.github.io/coursera_test/module3-solution/index.html

First layout

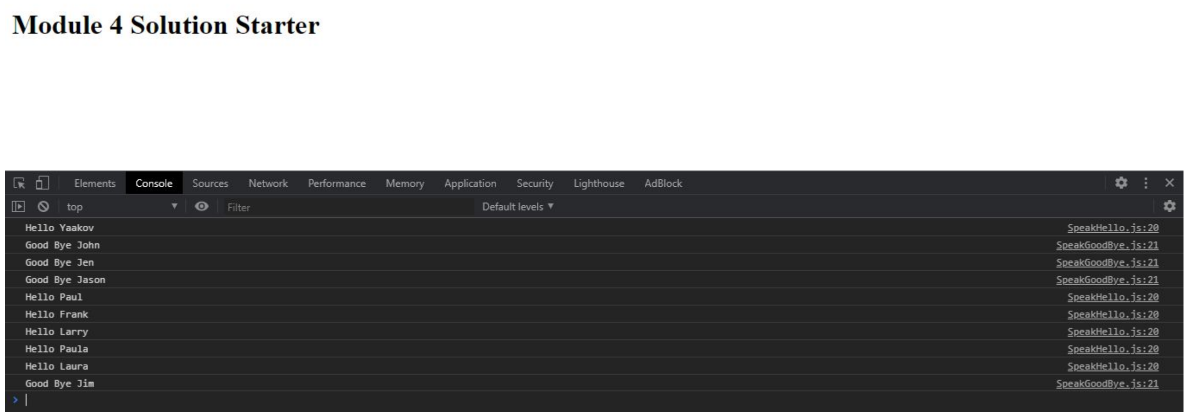
Second layout



HTML5, CSS3 and Javascript specialization Course Assignment 4:

In this assignment I had to develop the shown result that returns some data in the console of the browser (this can be seen through the browser's developer mode → console), this data is made by a Javascript file.

Link: https://fernandof117.github.io/module4-solution/module4-solution/index.html



HTML5, CSS3 and Javascript specialization Course Assignment 5:

In this assignment the objective was to create a randomizer of several categories for a restaurant's "SPECIALS" section in their web page. If you click on the "SPECIALS" button it show's you some dishes with their info, if you reload the page and click again on the "SPECIALS" button, it will show you different dishes with their respective info.

This whole website is made with HTML5, CSS3 with the bootstrap framework and some complex Javascript using JSON (JavaScript Object Notation) and AJAX (Asynchronous JavaScript And XML) to dynamically insert the main content.

Link: https://fernandof117.github.io/module4-solution/module5-solution/index.html

DAVID CHU'S CHINA BISTRO

KOSHER CERTIFIED

Menu | About | Awards

410-602-5008

* We Deliver

Chicken Menu

Orange Chicken

chunks of chicken, breaded and deep-fried with sauce containing orange peels; white meat by request: for pint $1 extra, for large $2 extra

$10.95 (pint) $14.95 (large)

General Tso's Chicken

chunks of chicken, breaded and deep-fried with sauce and scallions; white meat by request: for pint $1 extra, for large $2 extra

$10.95 (pint) $14.95 (large)

White Meat Chicken with String Bean

white meat chicken sauteed with string beans and soy sauce

$10.95 (pint) $14.95 (large)

White Meat Chicken with Eggplant In Garlic Sauce

white meat chicken, string beans, waterchestnuts, mushrooms, and eggplant, in garlic sauce

$10.95 (pint) $14.95 (large)

DAVID CHU'S CHINA BISTRO

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* We Deliver

Duck Menu

Peking Duck

marinated duck roasted crisp and served with pancake and green onion with special sauce

$28.95 (half) $52.95 (whole)

Crispy Duck

boneless duck meat, lightly breaded, deep fried to a crisp, topped with vegetables in chef's special sauce

$30.95

Duck with Vegetables

sliced lean duck meat sauteed with mixed vegtables in brown sauce

DAVID CHU'S CHINA BISTRO

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Menu | About | Awards

410-602-5008

* We Deliver

Side Orders Menu

Chicken Nuggets with French Fries

$7.25

French Fries

$4.25

Brown Rice

Extra White Rice

Direct Current Motor (Permanent Magnets) - Design and construction

The purpose of this project was to build a direct current motor capable of lifting 500 gr of load. The design was made in a CAD (Computer Assisted Design) software – Solidworks 2017 *(Figure 1)*, the stator and case were made by a 3D printer, the rotor is made of cold roll steel and was manufactured in a manual lathe machine *(Figure 2)*.

Internal coils, neodymium magnets and rotor are shown in *Figure 3* and the final product in *Figure 4*.

References

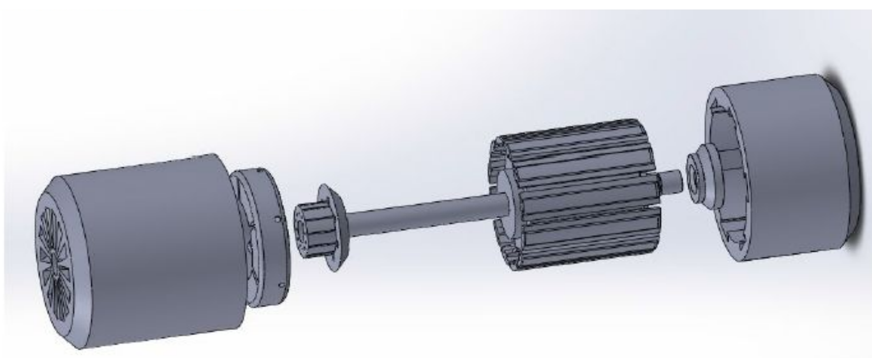


Figure 1: DC Motor CAD Design

Figure 2: Steel Rotor

Figure 3: Internal Coils, Rotor and magnets

Figure 4: Final Product

Video link

https://drive.google.com/file/d/1nPw5XAbz5QdbfCTyC_1-dwXtULyvxTFv/view?usp=sharing

Direct Current Motor PI Controller

The purpose of the project was to implement a digital PI (Proportional-Integral) control algorithm to regulate the DC (Direct Current) motor's rpm.

First we had to characterize the motor and its encoder with the help of a tachometer *(Figure 1)*, oscilloscope to determine the sensor's gain and the motor's gain *(Figure 2 and Figure 2.1)* to make the open loop transfer function and with the help of an IC (Integrated Circuit) LM331 we transformed the train pulses frequency given by the encoder into a voltage that could be read by the microcontroller ADC (Analog to Digital Converter) to have the sensor's data and to close the control loop (the circuit implemented is shown in *Figure 3)*.

Once we had the mathematical model, we transformed into the 'z' domain with binomial transformation and converting every term into discrete time (Figure 4), that allowed us to type the mathematical model in the Arduino environment, and with additional programming, an HMI (Human Machine Interface) was included. The HMI consisted of a LCD display and a numerical matrix keyboard so that the user could enter the desired rpm for the DC motor *(Figure 5 and Figure 6)*.

References

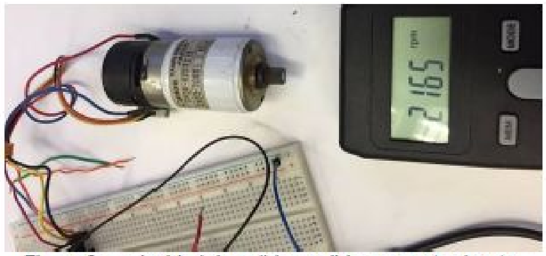


Figure 1: Characterization of the DC motor with a tachometer

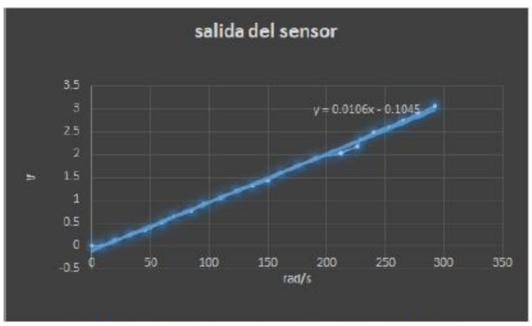


Figure 2: Sensor characterization curve

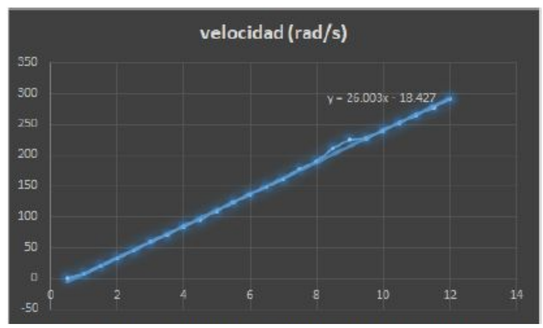


Figure 2.1: Motor characterization curve

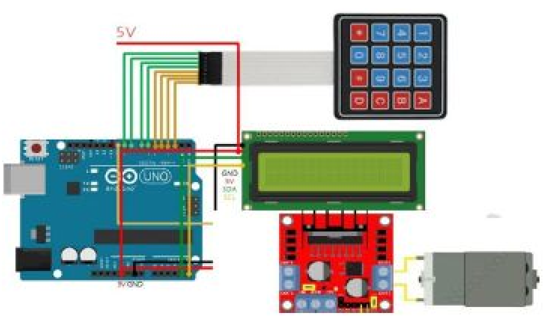


Figure 3: Final DC motor PI Controller Circuit Schematic

$$u_1(k) = k_p e(k)$$

$$u_2(k) = \frac{k_i T}{2} e(k) + \frac{k_i T}{2} e(k-1) + u_2(k-1)$$

Figure 4: System's mathematical model in discrete time

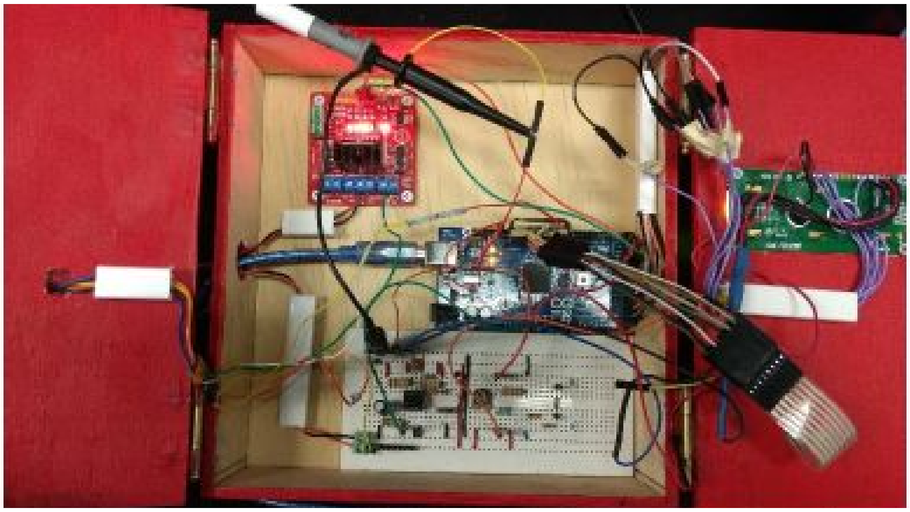


Figure 5: Internal connections of the system (HMI, motor and sensors connected to the microcontroller)

Figure 6: Final product

Video link

https://drive.google.com/file/d/1bXCX9odcJq7HtY3vcdwFYXqD76StjGIs/view?usp=sharing

Aeropendulum control

The objective was to design a pendulum which its angle could be selected by the user through an HMI (Human Machine Interface) within a range of 3° to 85°, the HMI we used was a TFT LCD (Thin Film Transistor Liquid Crystal Display) touch screen with several tabs to show important data like shown in *Figure 1 and Figure 2*. The angle was adjusted by a DC motor with a propeller, the lift produced by the motor increases the angle and gravity decreases it. The system was controlled by a digital PID (Proportional, Integral and Derivative) control algorithm that reached and maintained the user's input angle even with environmental disturbances.

The pendulum's base and arm were design in CAD software *(Figure 3)* and later 3D printed *(Figure 4)*; the arm axis was joined to a precision potentiometer that acted as the system's sensor and gave feedback to the microcontroller (Arduino) to complete the close loop control algorithm. The DC motor RPM (Revolution Per Minute) were controlled by a ESC (Electronics Speed Controller) that worked through a PWM (Pulse Width Modulation) signal made by the microcontroller digital output pins, everything was characterized so we could have a precise mathematical model of the system to achieve an accurate control.

References

Figure 1: HMI hardware

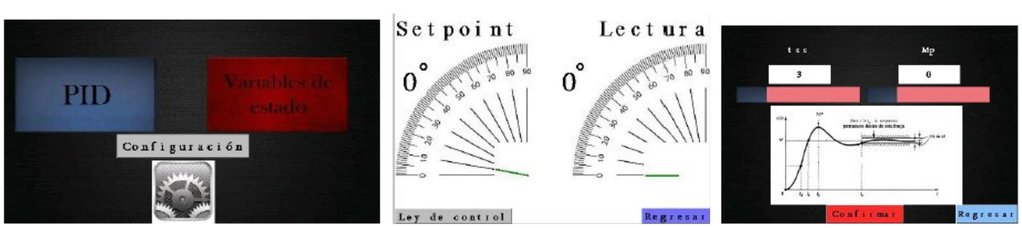


Figure 2: HMI tabs

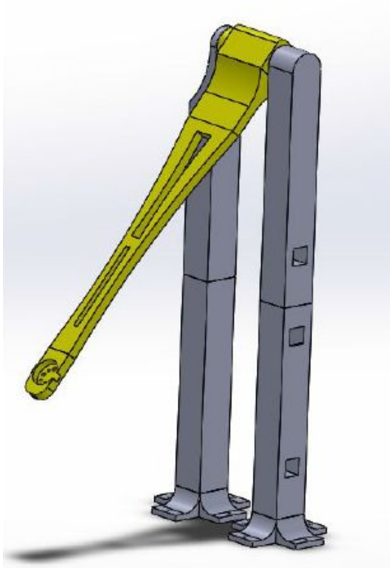


Figure 3: CAD model of the aeropendulum

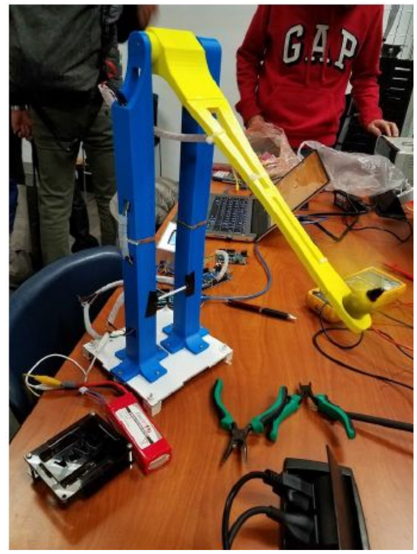


Figure 4: Final Product

Video link

https://drive.google.com/file/d/1thLOY2WVLdXHA8wVdjjbAebD-MjwV82G/view?usp=sharing

Delta Robot

The project's main objective was to build a 3 DOF (Degrees Of Freedom) Delta Robot, capable of following a "Pick and place" routine using direct kinematics, also it must had the option of position the robot's gripper with X,Y,Z coordinates with inverse kinematics equations. The HMI (Human Machine Interface) was made in LabVIEW 2017 as well as the programming *(Figure 1)*, the equations were inserted in a Matlab script and with some graphic programming we obtained the angle of each servo-motor for the desired x,y,z position or the position with the desired angles depending on mode that the user is on, the angles obtained were be used by the microcontroller to send the respective PWM (Pulse Width Modulation) to control each of the servo-motors angles.

All electronic components where solder into a PCB (Printed Circuit Board) to void short-circuits and to make connections easier like shown in *Figure 2, the system* was powered by a switch-mode power supply to guarantee a stable 5V voltage for all the components used in the project. Circuit schematic is shown in *Figure 3.*

The structure of the Delta Robot was made of Steel *(Figure 4)* some parts where solder to prevent structural failure in case stress was high. The gripper was made of acrylic moved by high-torque servo-motors to prevent excessive currents due to block rotors.

References

Figure 1: HMI and main program in LabVIEW environment

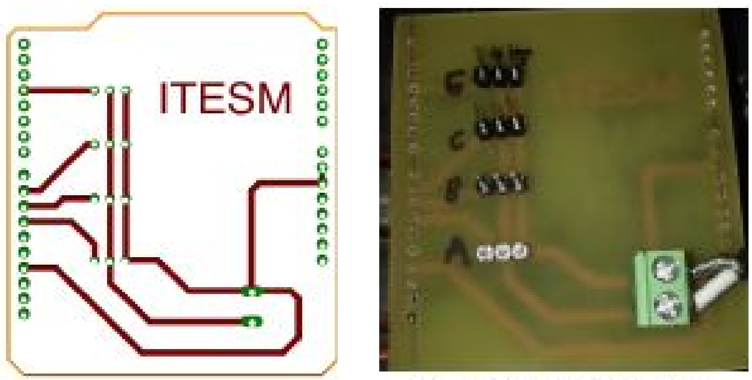


Figure 2: PCB design in Eagle

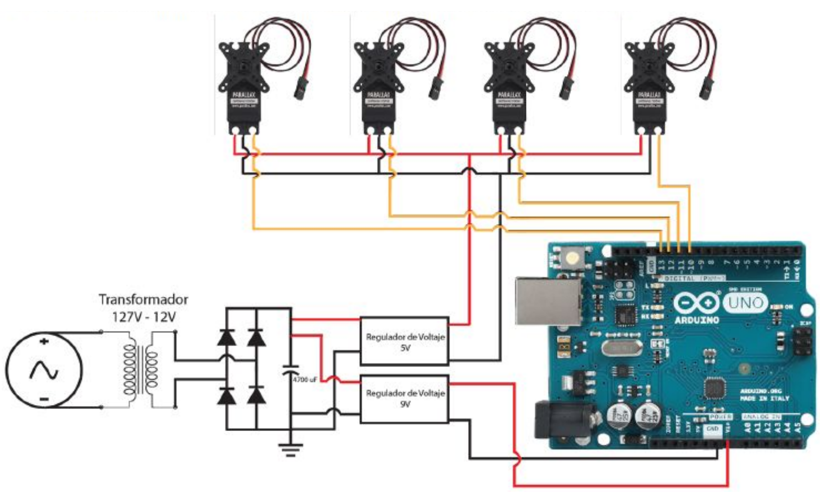


Figure 3: System's electronics schematic

Figure 4: Delta Robot's structure

Video link

https://drive.google.com/file/d/1YQ2-3s8-oc77zoDdPf2KhVMqqh6NE9_x/view?usp=sharing

Energy Distribution and Analytics

This project's purpose was to design a device related with sustainability, in this case we came up with an idea of a device that could process energy readings from a determined number of houses, so that these houses could be connected to an isolated solar panel grid with the objective of concentrating solar panels in one place optimizing the extra energy stored in the batteries by being used by anyone that needs it of the same grid. We noticed it's cheaper to make this solar panel grid than making a big infrastructure investment to expand the main grid to distant low income communities, and also it's cheaper that installing a solar panel, inverter, batteries and make isolated systems in each of this houses in were the extra energy creation would be wasted.

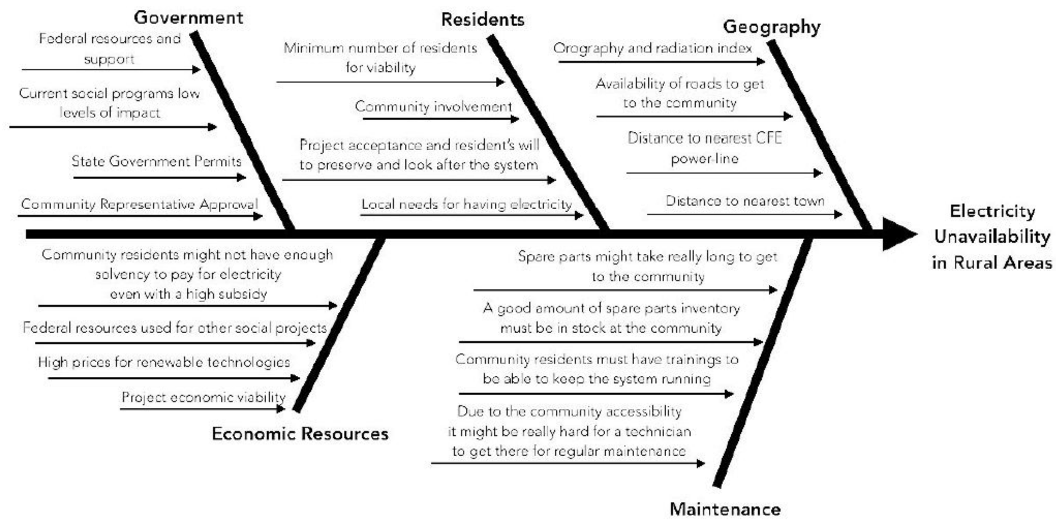
Some of the project requirements and criteria to be graded was to implement a variety of methodologies to reduce errors and time optimization in planning, construction and testing stages (Fishbone diagrams, Gantt diagram, IDEF0 (Integration Definition for Function Modeling), Poka Yokes, some international regulations and norms, QFD (Quality Function Deployment) matrix, morphological matrix, flowcharts, BOM (Bill Of Materials), FMEA (Failure Mode Effect Analysis), etc. -- *Figure 1*.

The system's hardware was modeled in CAD software and later a Finite element analysis was made according to the FMEA. Other simulations were made like circuit nominal operating temperature, proper connections, etc. *(Figure 2)*.

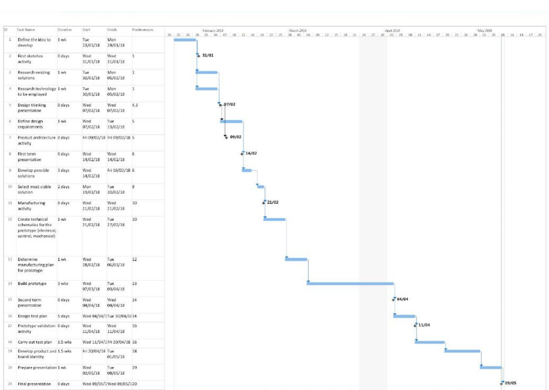
The electric components were solder and placed in a PCB *(Figure 3)* and the enclosure was manufactured with milling machine and other tools for precision *(Figure 4)*.

The HMI consisted of the energy readings from each house and the data was acquired from the sensors was transmitted to the microcontroller and to a computer through serial communication, the readings were uploaded to a server for storage and further analysis *(Figure 5 and Figure 6)*.

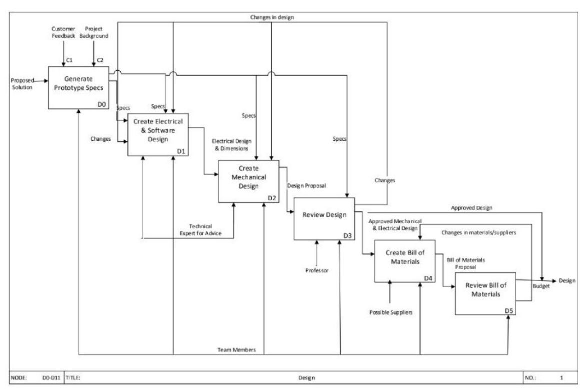
References



Fishbone Diagram



Gantt Diagram



IDEF0

Figure 1: Some of the project's planning activities

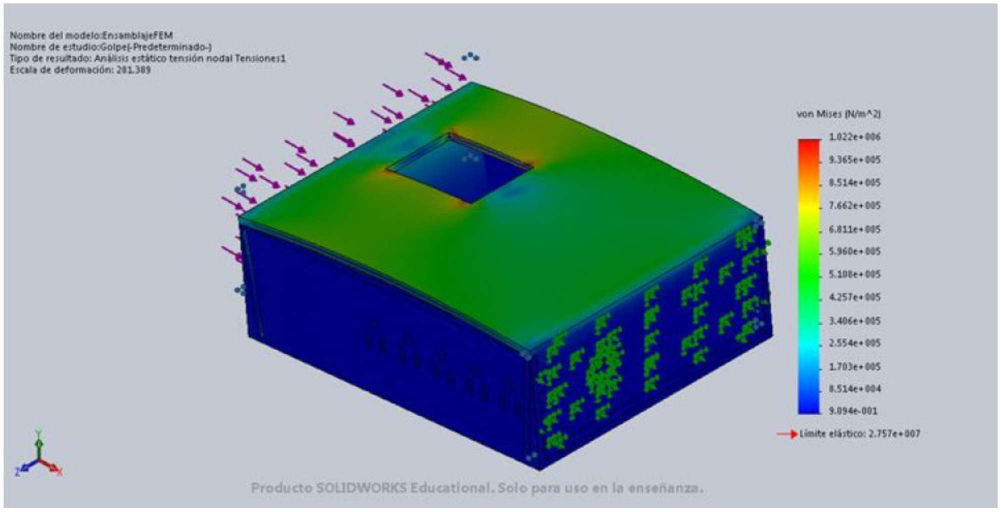


Figure 2: FEA Structural analysis in CAD/CAE software

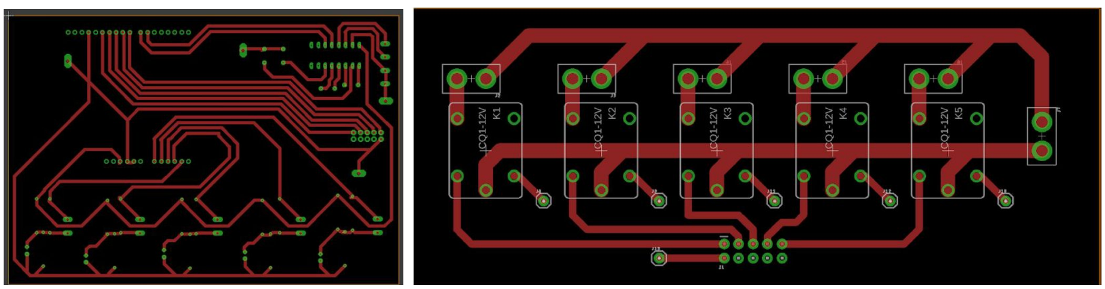


Figure 3: System's data conditioner and relays PCB

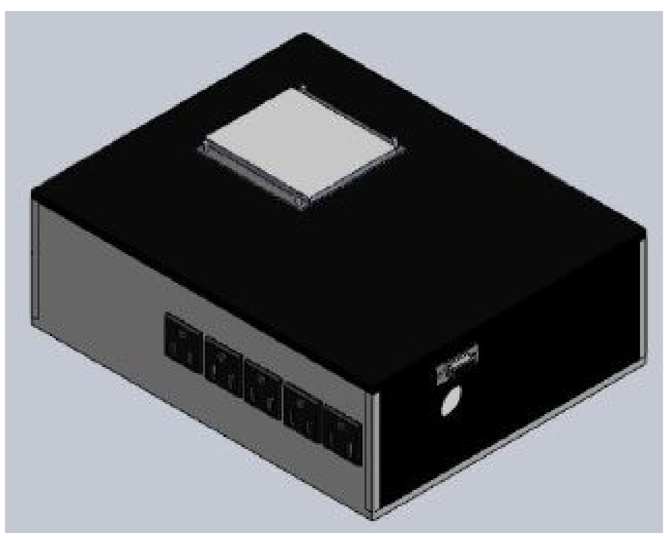


Figure 4: System's enclosure

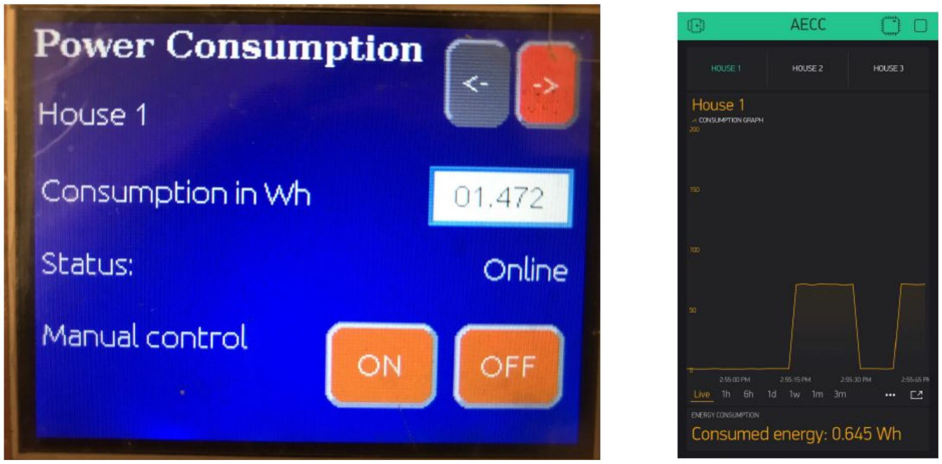


Figure 5: HMI Data acquisition

Figure 6: Final Product connected to the sensors and computer

Video link

https://drive.google.com/file/d/1-a7aBiGclsqHRDEL1aUEeOKOMQzvByU7/view?usp=sharing

Cellular Manufacturing

Now more than ever CNC (Computer Numerical Control) machines are being used in the manufacturing industry for their accuracy and high rate of production, they are different machines like the milling machine where the tool is the one that spins or the lathe machine that is the material the one that spins and the tool moves through the machine's axis to shape the material.

In this project we combined several CNC machines with the objective of simulating an industry cellular manufacturing process capable of making a product with the specifications shown in *Figure 1*.

The cell consisted of 8 elements *(Figure 2)* and manufacturing process was made by running 14 programs. A FANUC robotic articulated arm (Robot 1) took the raw material (aluminum cylinder with some initial size specifications - *Figure 3*) from the storage, left it on a pallet 3 where another articulated robotic arm (Robot 2) took it and placed it into the KIA CNC lathe machine, once the CNC lathe machine program was over, the door automatically opened so that the Robot 2 could now move the new shaped cylinder into the CNC milling machine, after the milling machine routine was over, the next step was to return the final product to the metal pallet 2 where the first articulated robotic arm could transport it back into the storage.

Manufacturing Steps:

1. Unloading from the storage
2. Placing the raw material on pallet 3 (Robot 1)
3. Picking the raw material from pallet 3(Robot 2)
4. Load the raw material into the CNC lathe machine (Robot 2).
5. CNC lathe machine program.
6. unload the new cylinder from the CNC lathe machine (Robot 2)
7. Place the new cylinder on pallet 1 (Robot 2)
8. Pick again the piece from pallet 1 (Robot 2)
9. Load the piece into the CNC milling machine (Robot 2)
10. CNC milling machine program
11. unloading final product from the CNC milling machine (Robot 2)
12. place the final product on pallet 2 (Robot 2)
13. Pick the final product from pallet 2 (Robot 1)
14. Place the final product into the storage (Robot 1)

The 14 steps are shown in *Figure 4*.

References

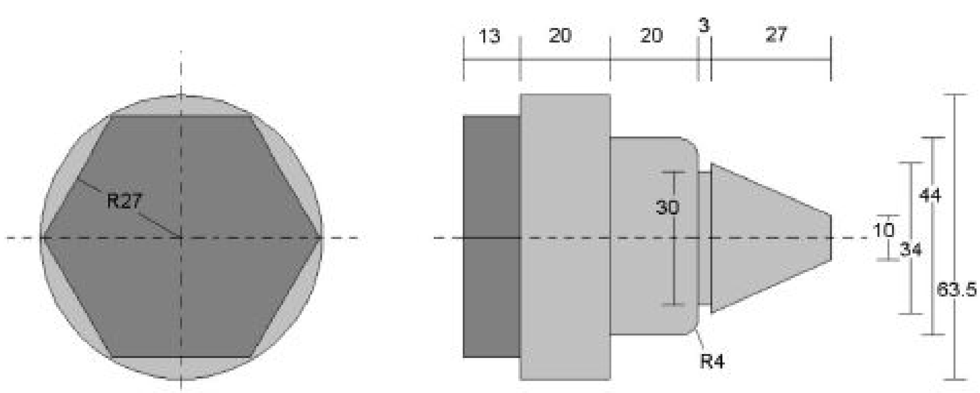


Figure 1: Sketch of final product dimensions in millimeters

Figure 2: Manufacture cell and its elements (Storage, robots, pallets, lathe and milling CNC machines)

Figure 3: Raw material with initial dimensions in millimeters

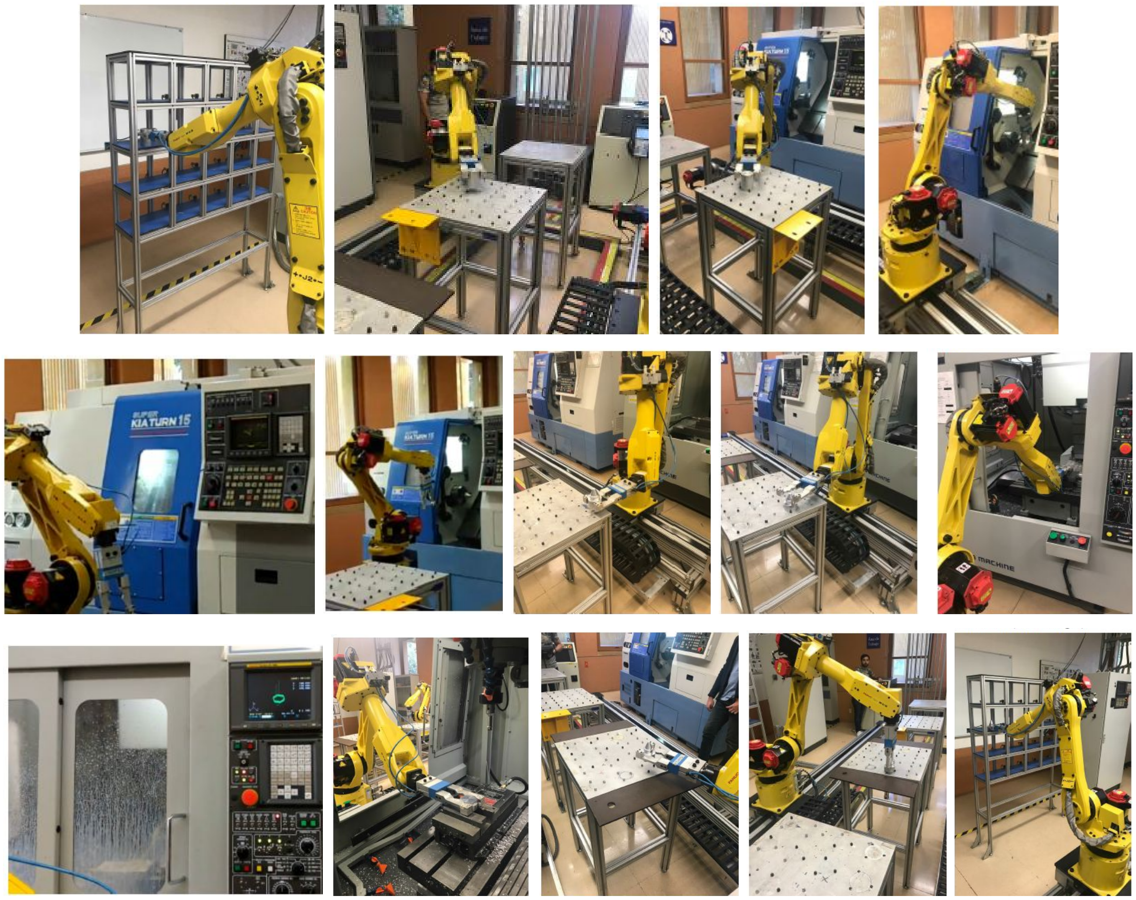


Figure 4: All 14 steps for the manufacturing process

Video link

https://drive.google.com/file/d/1NomM3g6-GDVcIeBq1SGCuXWmON4HiHbX/view?usp=sharing

Electro Bike

The goal in this project was to create a device that must had some mechanical, electrical and control engineering theory and application.

I wanted to add some sustainability focus to the project so the core ideas was to develop a device that could provide pedaling assistance to any bike user by converting their bicycle into a pedal electric cycle (pedelec) to encourage the citizens that work or study nearby their homes but for lack of efficient public transportation, medium range distances (too long to travel by foot) or steep roads, they prefer to take the car instead of the bicycle.

I made different quick prototypes that once they were tested they revealed possible improvements.

The electric motor was chosen, according to the time and budget available, the problem with the available DC motor was that it provided more rpm than necessary and the torque was not enough to move a 70 Kg person, so the solution was to design a planetary gearbox (the gearbox was not linear because of space constrictions) that would reduce the 2,000 rpm at 12V into 421 and increase the torque *(Figure 1)* the sun gear was attached to the DC motor rotor and the resulting rpm and higher torque created by the speed reduction between the planet gears and the crown gear, the torque was transmitted to a link that made a wheel rotate and through friction transmit power and propel the bike forward like shown in *Figure 2*. The gears were initially manufactured in a 3D printer for easier and faster prototyping.

The electrical schematic was made in Multisim, it consists of a power transistor TIP31C or TIP120 capable of handling high currents (up to 10A), the gate was going to be controlled by a microcontroller which was going be controlled with a trigger or a variable resistor *(Figure 3)*.

The control to be added was a PI controller that regulates the motor rpm and therefore the bicycle's speed so we characterized the motor *(Figure 4)* and the sensor to obtain their respective gains and build a mathematical model - transfer function.

The final prototype is shown in figure 5. The system has sliders so it could be adjusted to any bike.

References

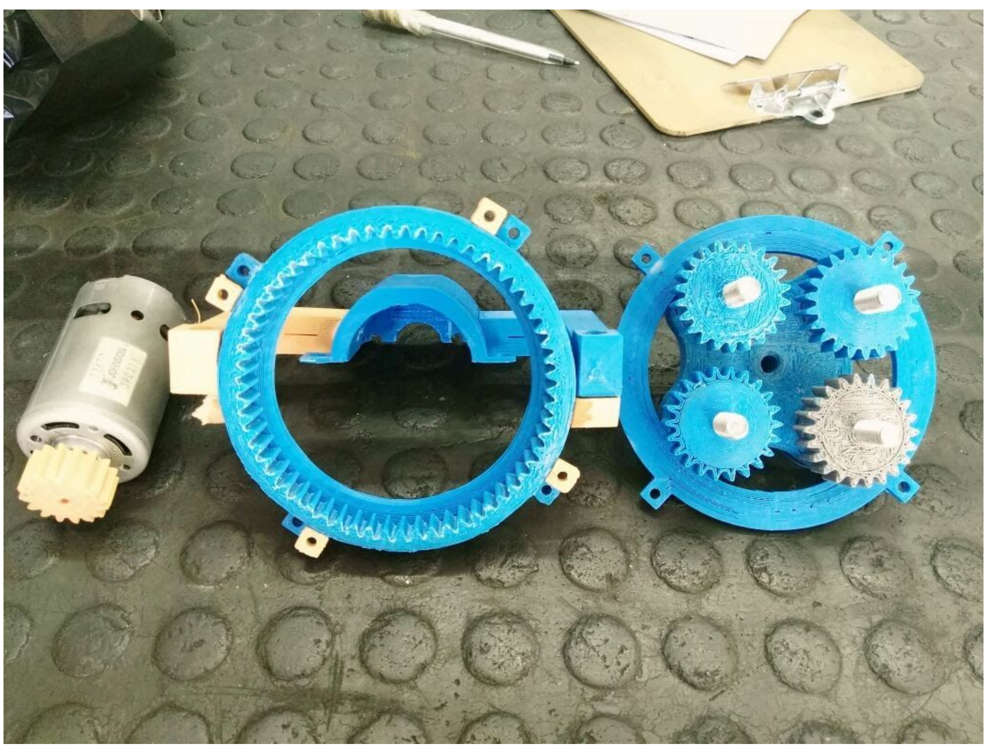


Figure 1: Planetary gearbox prototype

Figure 2: Prototype System mounted

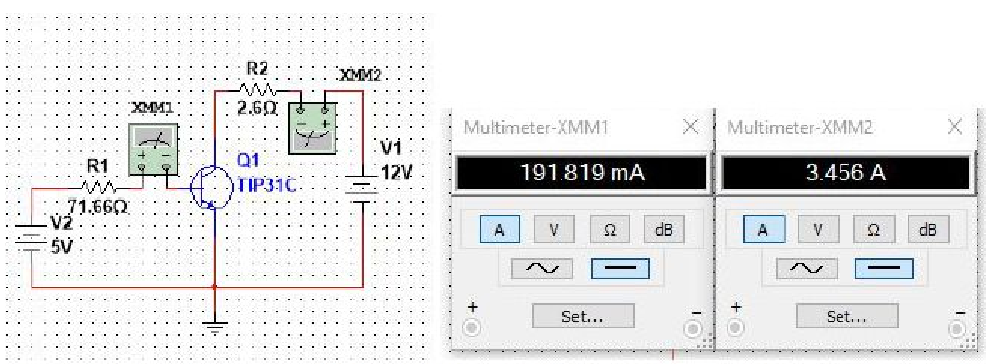


Figure 3: Transistor circuit in Multisim

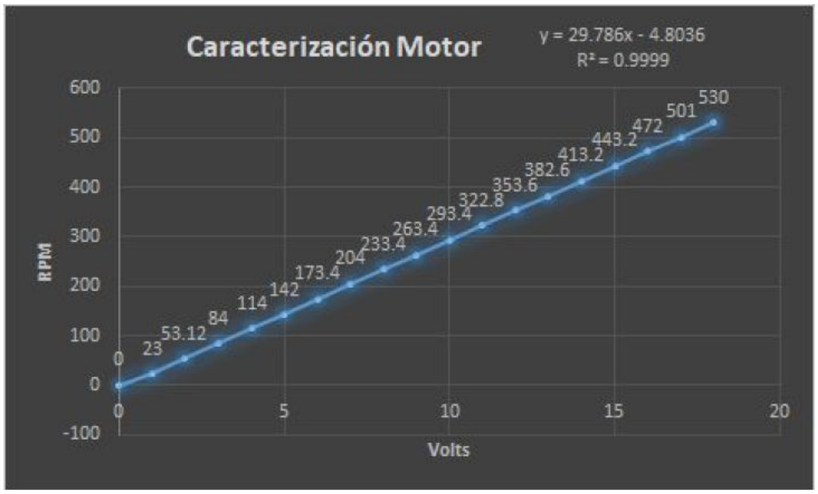


Figure 4: Characterization curve of the DC motor

Figure 5: Final prototype

Video link

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https://drive.google.com/file/d/1_ehJCmO2RDOBqgNzRCIl9fKcPkdXzMb7/view?usp=sharing

https://drive.google.com/file/d/1FU0bJqKQdud_S2xuhyjvLm5gJf0Yh4F5/view?usp=sharing

CFD CAE Simulation and Dynamic Analysis

CAD/CAM (Computer Assisted Design/Computer Assisted Manufacturing) software is very important tool in any product design stage. We can have preliminary results of several analysis without having to manufacture the product. This is very convenient in case the physical prototype consumes a lot of time and resources, for example a Car.

In this project we had to design several components of a car chassis and suspension *(Figure 1)*, once we had the geometries, we could make a dynamic analysis to extract important data like dampers and coil spring displacements like shown in *Figure 2 and Figure 2.1.*

In another project we created a basic car chassis that had to be analyzed with CFD (Computer Fluid Dynamics). With Advanced Thermal-Flow solution type and turbulence model K-Epsilon we created 2D meshes assigned with different materials, 3D meshes that had as assigned material pure air. like shown in *Figure 3.* Once we had the meshes, to simulate air flow, we determined the air intake and exit, a MRF was created (Moving Reference Frame) to “make” the air rotate around the car’s fan and make a more precise calculation of the drag and lift coefficients created by the car. The resulting air flow and coefficients are shown in *Figure 4* and *Figure 5* respectively.

References

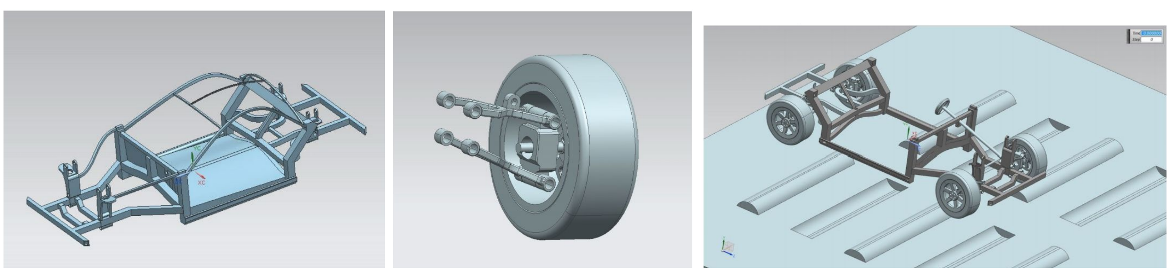

Figure 1: Chassis and suspension design in NX 8.0

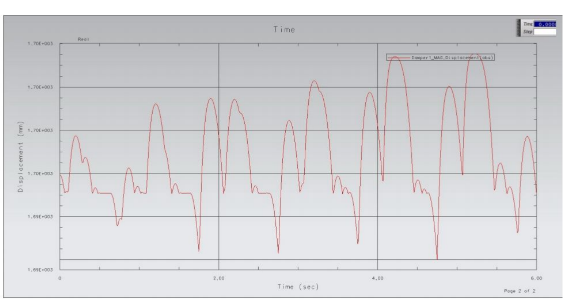

Figure 2: Dampeners displacement in millimeters

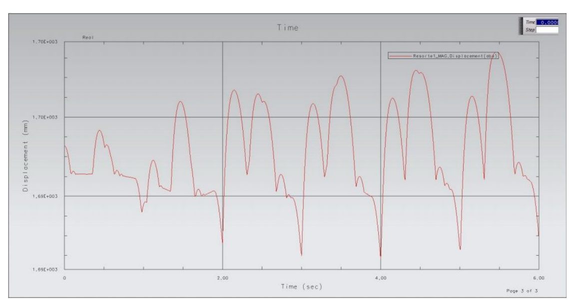

Figure 2.1: Coil springs displacement in millimeters

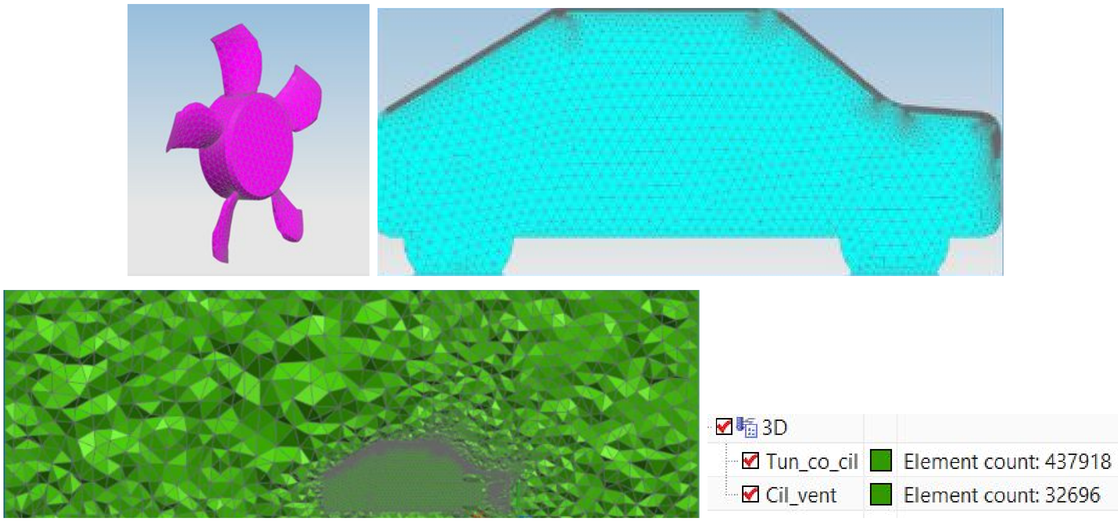

Figure 3: 2D and 3D Meshes

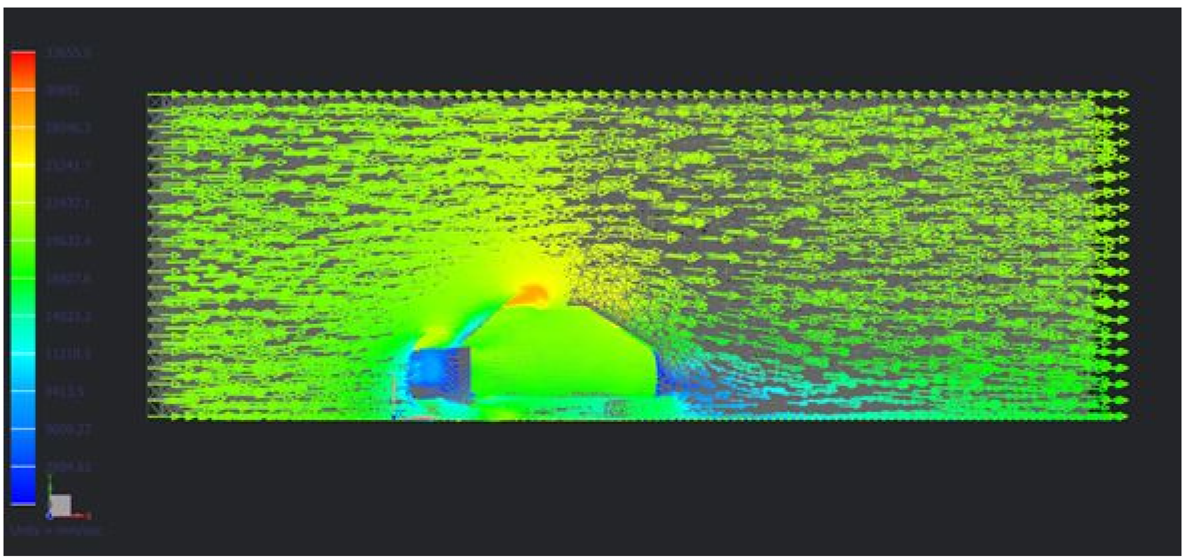

Figure 4: Air flow speed results

Lift Drag

Group	Time	LIFT-X	LIFT-Y	LIFT-Z	LIFT-Mag.	LIFT-Coef.	DRAG-X	DRAG-Y	DRAG-Z	DRAG-Mag.
Lift_Drag	0	0	1	0	294481	0	1	0	0	239463

Figure 5: Resulting Lift and Drag coefficients