Terence Lee, tklee3, ECE 120
Jia En Wang, jiaenew2, ECE 110
Cheng Xu, chengx2, ECE 110 & 120

ECE 110/120 Honors Lab Project Page

I. Introduction

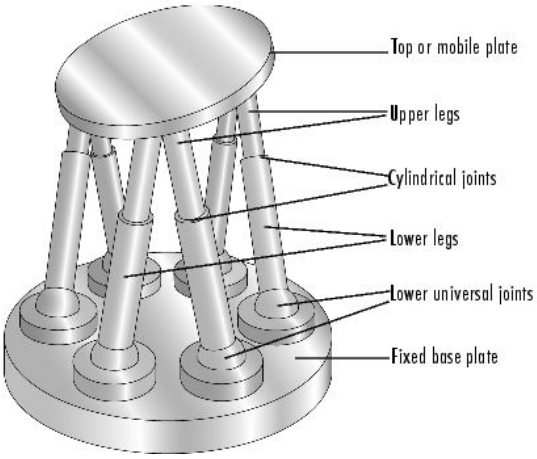
A. Statement of Purpose

1. We are planning on building a six degree of freedom stewart platform. Currently we are fielding two different applications of the stewart platform each with different degrees of difficulty/time required. The first application would be connecting the platform to a racing simulator and replicating the movements of the vehicle onto the platform. The second application would be attaching a resistive touch panel and using the stewart platform to balance a marble. Once our team has a functional device, we plan on choosing one of the applications depending on the time remaining in the semester.

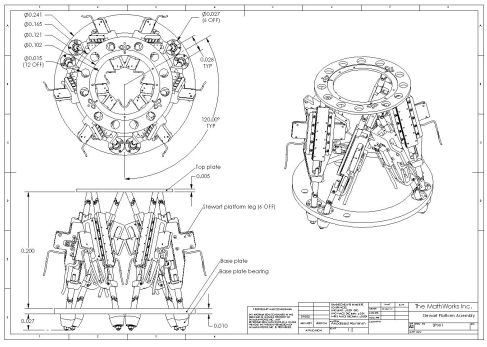
B. Background Research

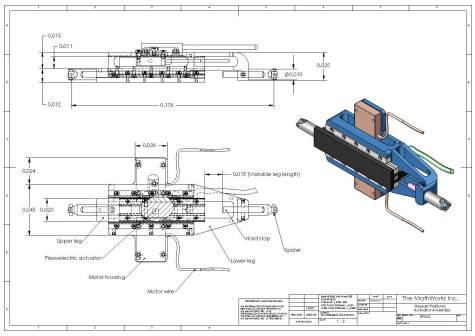
1. Originally designed by Eric Gough in 1954, the stewart platform contains six actuators that allow for a plate placed on top that can be programmed to rotate three ways (pitch, roll, and yaw) to achieve 6 degrees of freedom simultaneously.
2. https://youtu.be/WmKnnp1xTPg
3. Simscape Multibody is a versatile platform which simulates 3d mechanical systems such as models like our stewart platforms or suspension and hydraulic models. We can use the simscape multibody stem to simulate the motion by representing the physical components as blocks. Additionally, we are able 3d models into Multibody and modify the schematic from there. Lastly, having some experience in Matlab will s facilitate the process in modifying the digital model. Another benefit of using multibody is the ability to simulate the different environments that our model will encounter such as the object type, DOF angles and severity of weight shift.

4.



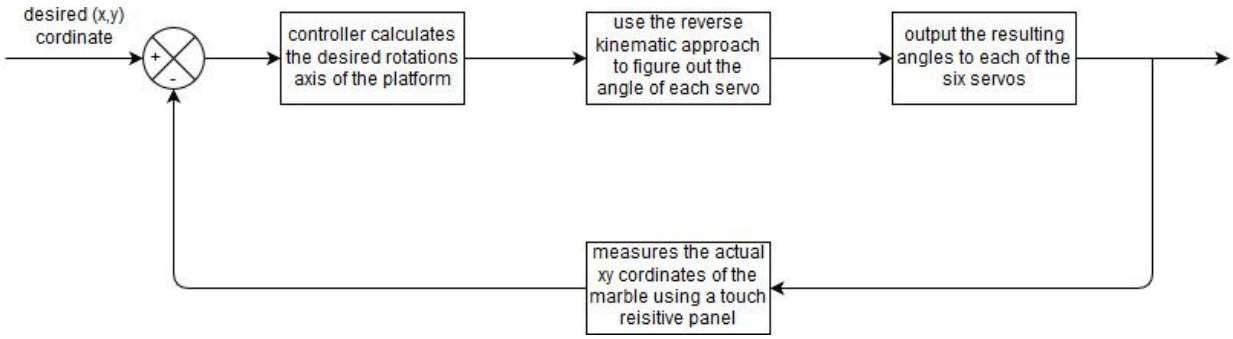
5.





II. Design Details

A. Block Diagram/ Flow Chart



B. System Overview

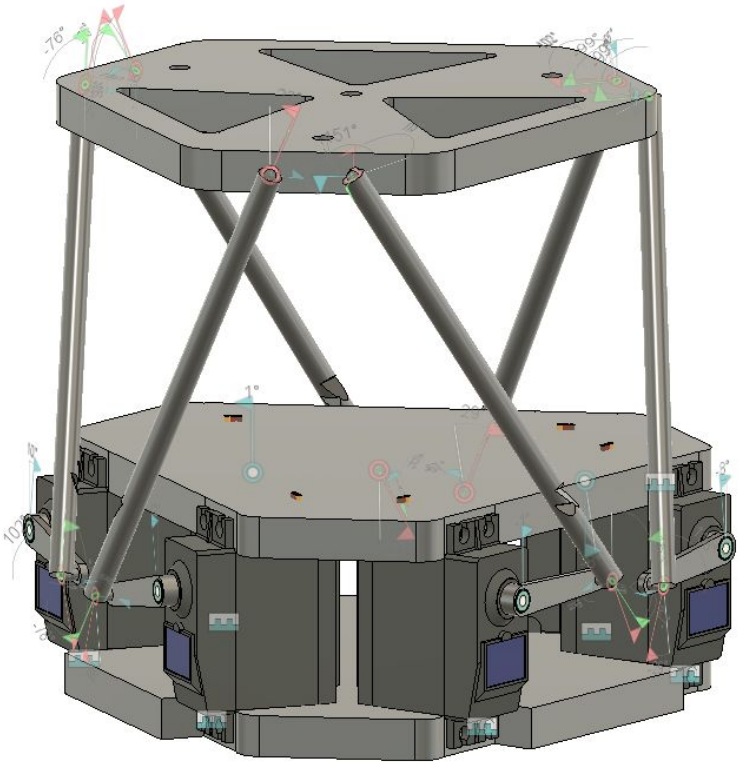
1. We input a desired coordinate for the marble, and the controller calculates the difference in distance and angle between the actual position and the desired one. The controller then determines the axis of rotation and convert it into euler rotations. It then uses inverse kinematic approach to calculate the angle of each servos. After the servos are turned to the desired position, the resistive panel again measures the position of the marble and and feeds it back into a PID control loop.

III. Parts

- 6*Servo - Hitec HS-425BB
- 1*ATMega328P
- various laser cut pieces
- ZIF Socket 28-Pin 0.3"
- DIP Sockets Solder Tail - 28-Pin 0.3"
- Solder-able Breadboard
- 6*end control rod
- Touch Resistive panel

IV. Design

A. (1st Iteration Fusion)



B. (2nd Iteration Solidworks)

V. Possible Challenges

A. *Please list some of the challenges that your group foresee in working on your project.*

1. One of the more significant challenges that our group may face are the programming tasks. We will be able to use libraries but we will need to manually develop the code ourselves. We must collaborate by understanding how the code harmonizes to create a functioning stewart-platform. We need to at least understand the fundamentals in how the program works so that we can identify issues quickly and mitigate them with precision.
2. Another potential issue we see arising is the physical process of building the machine itself. Many times, physical components are constructed incorrectly such as when wires are reversed or when rods are connected to the wrong slots. Additionally, some of the components listed are quite fragile so our group will need to take great care in making sure we do not damage or break any components to keep costs down.
3. Financial costs are an essential part of any ece project but our stewart platform is simple yet functional. Total costs will hover around the two hundred dollar range plus or minus a few dozen dollars.
4. Lastly, scaling is a substantial issue where we need to make sure that our model is proportional in size in relation to a full scale stewart-platform. Scaling is a significant issue to tackle because we need to make sure we get the balance right in order for the platform to stabilize objects on the glass display. If we don't get scaling right, physical properties may be shifted and our stewart platform may not be well balanced.

VI. References

A. D. Stewart, "A Platform with Six Degrees of Freedom", *Aircraft Engineering and Aerospace Technology*, vol. 38, no. 4, pp. 30-35, 1966.

B. V. Gough, "Contribution to discussion of papers on research in Automobile Stability, Control and Tyre performance", *Proc. Auto Div Inst. Mech. ENg.*, vol. 392-394, 1956.

C. "About the Stewart Platform- MATLAB & Simulink", *Mathworks.com*, 2018. [Online]. Available: https://www.mathworks.com/help/physmod/sm/mech/ug/about-the-stewart-platform.html. [Accessed: 16- Sep- 2018]

Links:

- http://fullmotiondynamics.com/
- https://github.com/tcleg/Six_Axis_Complementary_Filter
- https://www.youtube.com/watch?v=j4OmVLc_oDw
- http://makezilla.com/2016/01/30/arduino-controlled-rotary-stewart-platform/
- https://appliedgo.net/roboticarm/
- https://www.mikroe.com/blog/capacitive-vs-resistive-touch-panel-feels-better

Github Repositories

https://github.com/ThomasKNR/RotaryStewartPlatform
https://github.com/MarginallyClever/Rotary-Stewart-Platform-2-firmware
https://github.com/patrickLangan/stewartPlatform
https://github.com/scottbarnesg/Stewart-Platform-Sim
https://github.com/hbartle/Stewart_Platform