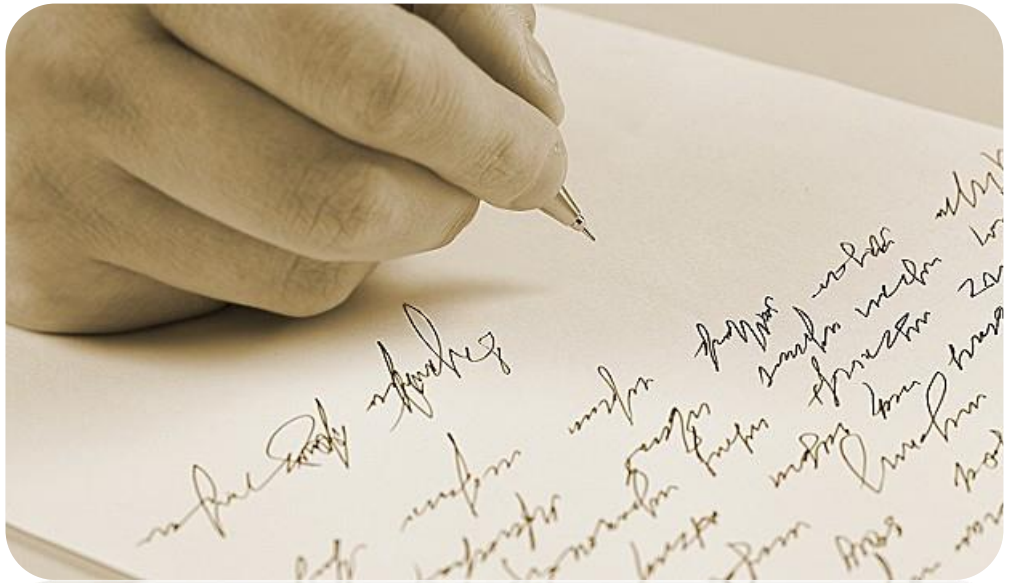
CATCH ME IF YOU CAN…

Advanced Mechatronics :

Arduino Mini Project



Presented By:

Federico Gregori

Karim Chamaa

Presented to:
Dr. Vikram Kapila

Outline

- Introduction
- Building the Prototype
- Theoretical Analysis
- Circuit Design
- Coding
- Cost Analysis
- Future Improvements
- Conclusion

Introduction

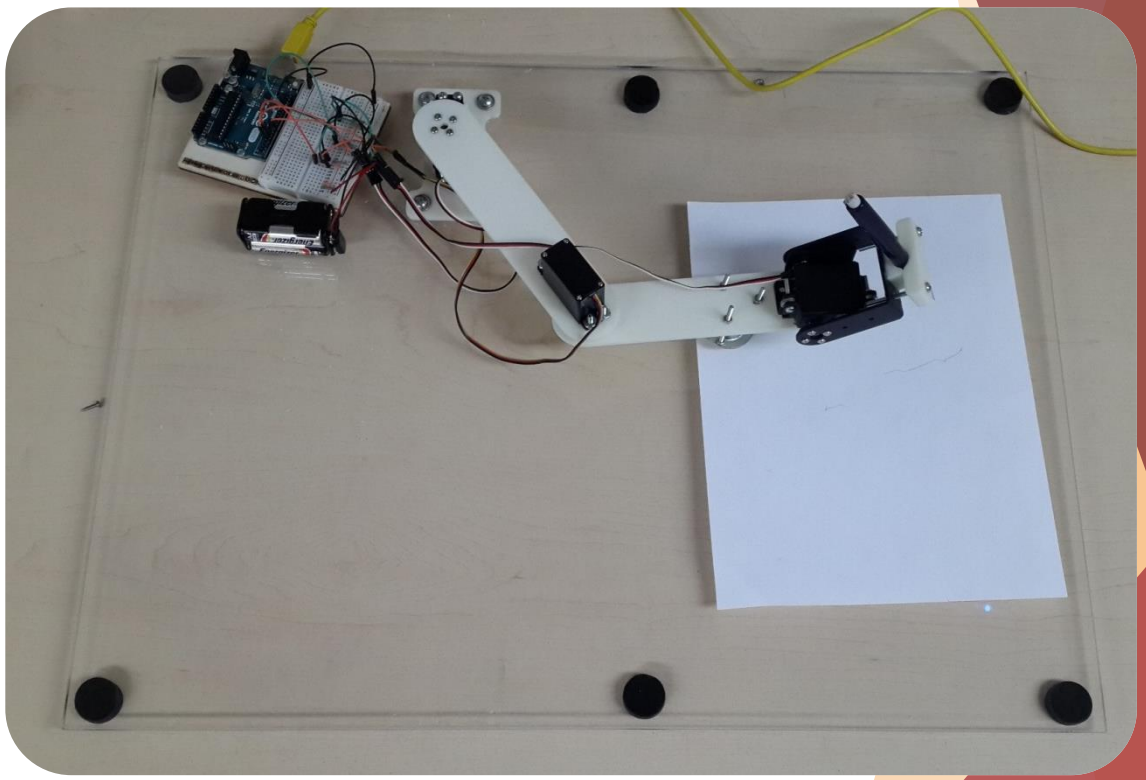
- This device is thought to reproduce any hand-writing picture.
- It can satisfy the necessity to sign a document with a real pen from a long distance.
- The system acquires the picture from an external device and duplicates it on a paper.

Building Prototype

Building an automated 3 DOF manipulator:

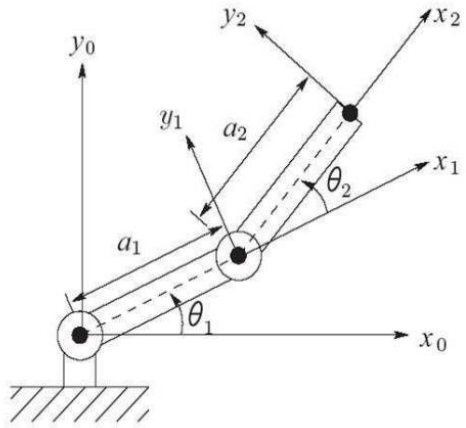
Structure:

- Two joints moved by two motors to control the translation of the plane of the paper
- One joint to control the component normal to the paper
- 3D Printed links
- Ball caster to add stability to the system
- End effector with pen attachment



Theoretical Analysis

2 DOF Inverse Kinematics:



$$\frac{x^2 + y^2 - \alpha_1^2 - \alpha_2^2}{2\alpha_1\alpha_2} := D$$

$$\theta_2 = \tan^{-1}\frac{\pm\sqrt{1 - D^2}}{D}$$

$$\theta_1 = \tan^{-1}(y/x) - \tan^{-1}\left(\frac{\alpha_2 \sin\theta_2}{\alpha_1 + \alpha_2 \cos\theta_2}\right)$$

Minimum Distance Between 2 Points:

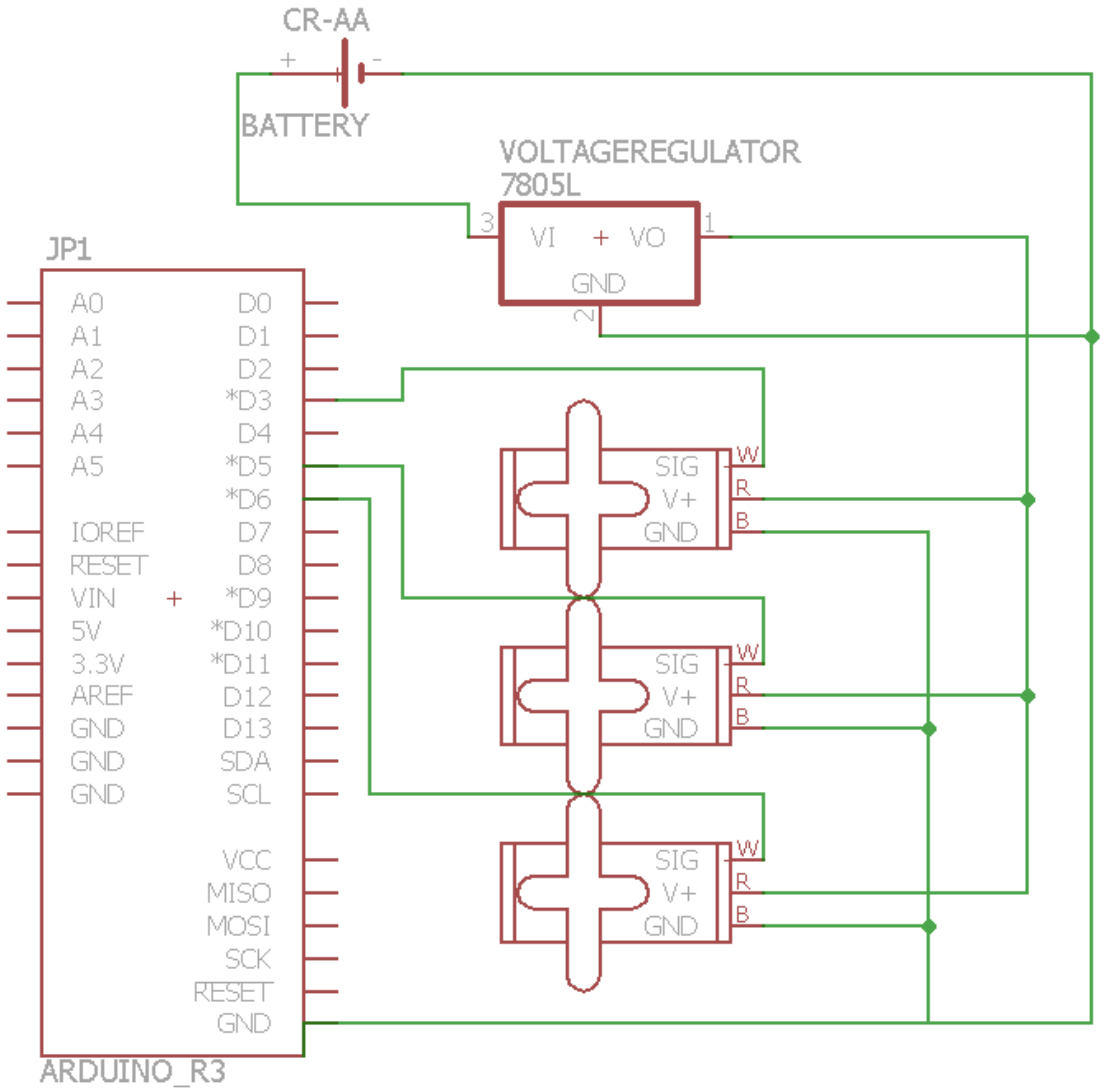
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

writeMicroseconds():

$$\text{Servo1}(\mu s) = 2900 - \left(\left(\frac{95}{9} * Angle\right) + 500\right)$$

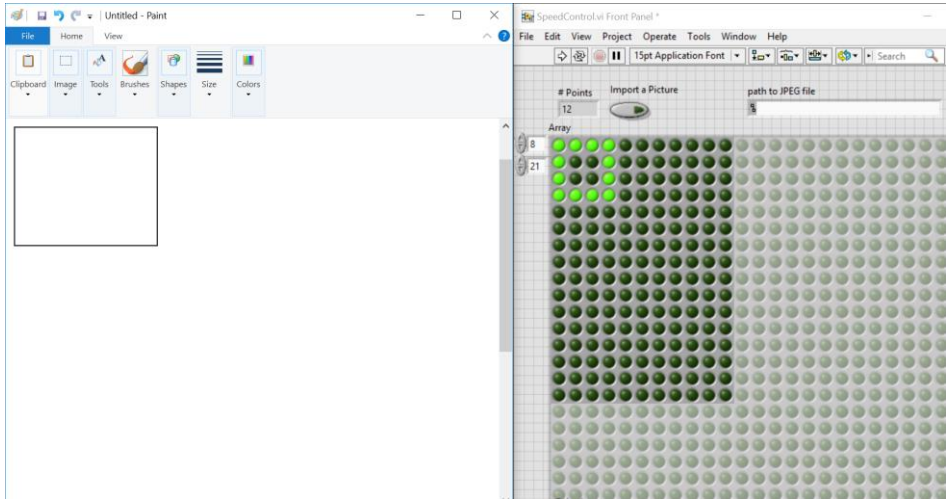
$$\text{Servo2}(\mu s) = \left(\left(\frac{95}{9} * Angle\right) + 500\right)$$

Circuit Design

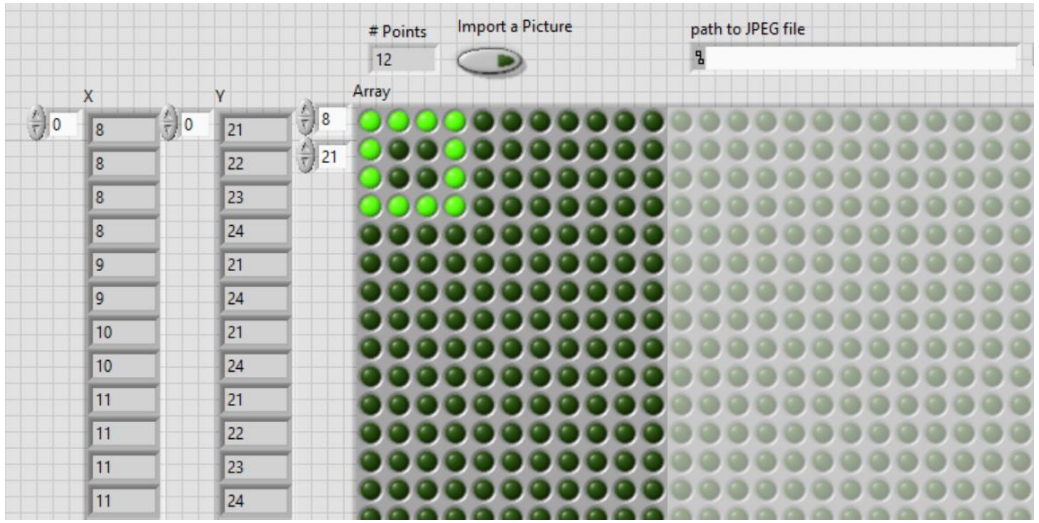


Coding

STEP1 Acquiring an image from paint and transforming it into a matrix.

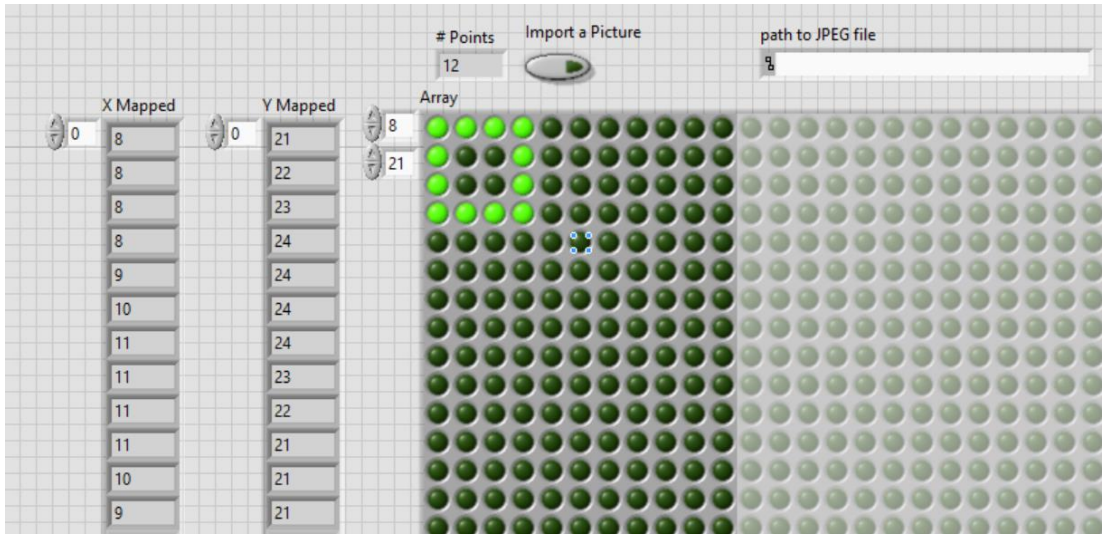


STEP2 Selecting the points that represent the image.

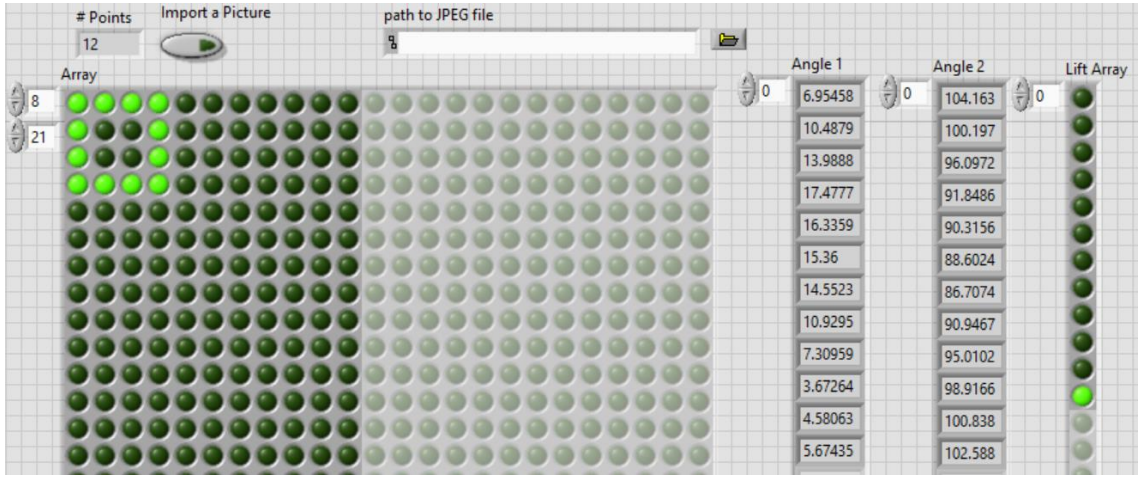


Coding

STEP3 Creating an algorithm to map the selected pixels.

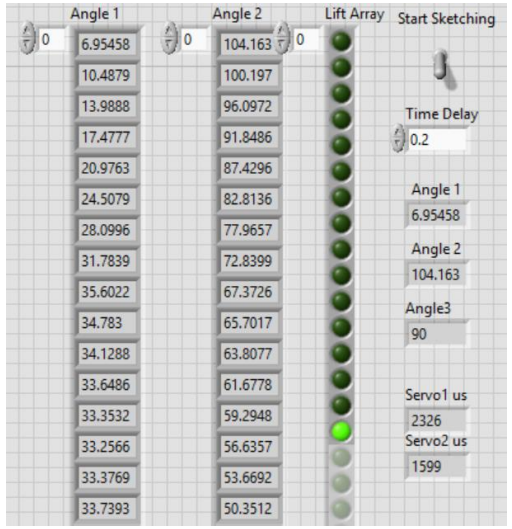


STEP4 Applying the inverse kinematics equations and finding the corresponding angles.



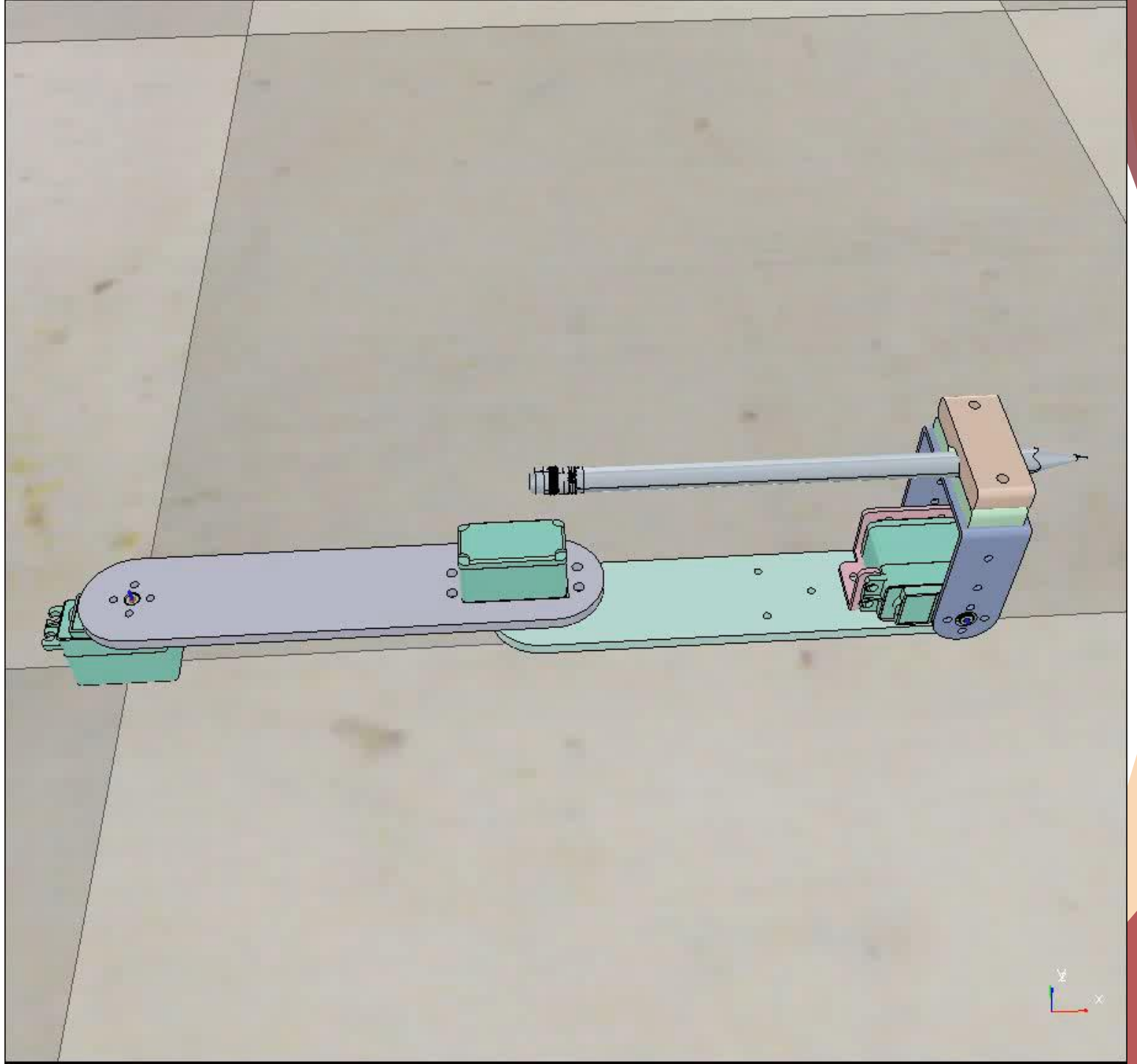
Coding

STEP5 Converting Angles in Degree to Microsecond Units



STEP6 Writing the corresponding Angles to the Three Servos

v-rep



Cost Analysis

Materials	Quantity Usage	Unit of Measure	Unit Cost	Usage Cost
Plexiglas	1	Each	24	24$
Bolts and Nuts	1	Each	5$	5$
Servos	3	Each	25$	75$
Printing Parts	1	Each	15$	15$
Arduino Uno	1	Each	15$	15$
Breadboards	1	Each	5$	5$
Jumper Wires	1	Each	14$	14$
Lippo Batteries	2	Each	10$	20$
Voltage Regulator	1	Each	1$	1$
		Prototype Total Cost=		174$

PaintImage - Paint

File Home View

Paste Cut Copy
Clipboard

Select Crop Resize Rotate
Image

Tools

Brushes

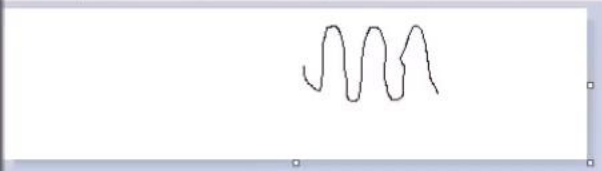
Shapes

Outline Fill

Size

Color 1 Color 2

Edit colors
Colors



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Ask me anything

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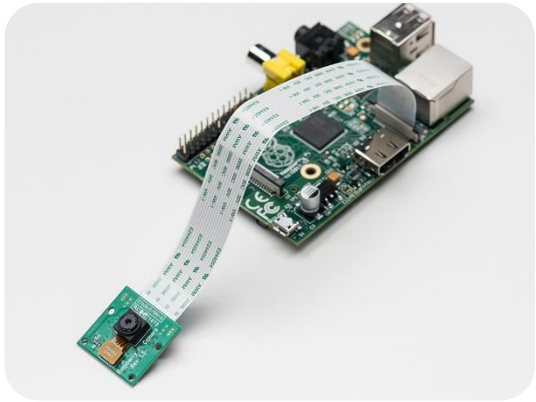
Future Improvements

- Improving the stability of the system by implementing high torque servo motors.

- Acquiring an image through the raspberry pi cam and processing it which will eliminate the need of LabVIEW.



Conclusions

- This robot will provide an inexpensive solution to a possible user need
- The system need more stability to operate correctly
- Actual servos can not carry out the torque requested to place the pen
- The code can be modified to obtain more regular trajectories
- The structure of the system can be enhanced to reduce the friction with the paper and the stresses on the motors

Thank You

Questions ?