

▶ Monitor Motion Mechanism

Special Project for INME 4005

Kinematic Design ▶ INME 4005 Sec.010 ▶ .

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Project Statement

In this project we made an effort to solve a design problem using a mechanical synthesis. The objective is to design a mechanism that will dynamically put the monitor in three different positions. We used the knowledge gained in kinematics design class to analyze position, velocity and acceleration of the mechanism. The process consists of three parts:

- Brainstorming for different designs that fit the project requirements
- Overview and analysis of different mechanisms our group suggests
- Construction of a prototype based on the most efficient and simple design.

The group studied the requirements beforehand and decided that the best way to make the mechanism was to use the lesser parts possible in order to make the simplest, most user-friendly monitor motion mechanism. This way it would be efficient while being cost-effective at the same time.

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Problem Description

A mechanism will be designed to carry a computer monitor from a viewing position to a storage position in a standard desk. Since the position and angle of the monitor are being controlled, the problem is one of *motion generation*. A sample set of precision positions is provided in Figure 1. No links of the mechanism can go above the top surface of the desk or below the floor.

Furthermore, for safety and appearance, no portion of the driver or follower links of the mechanism will be allowed to move out the back of the desk or in the leg region. Therefore, all pivots of the mechanism should stay contained within the 505 X 685 mm dashed envelope shown above throughout the entire range of motion of the linkage.

PP1: $x_1 = -305$ mm, $y_1 = 0.00$ mm, $\theta_1 = 0^\circ$ (viewing position)

PP2: $x_2 = -270$ mm, $y_2 = -343$ mm, $\theta_2 = 8^\circ$ (intermediate position; clears corner of desk)

PP3: $x_3 = 25.4$ mm, $y_3 = -370$ mm, $\theta_3 = 0^\circ$ (storage position)

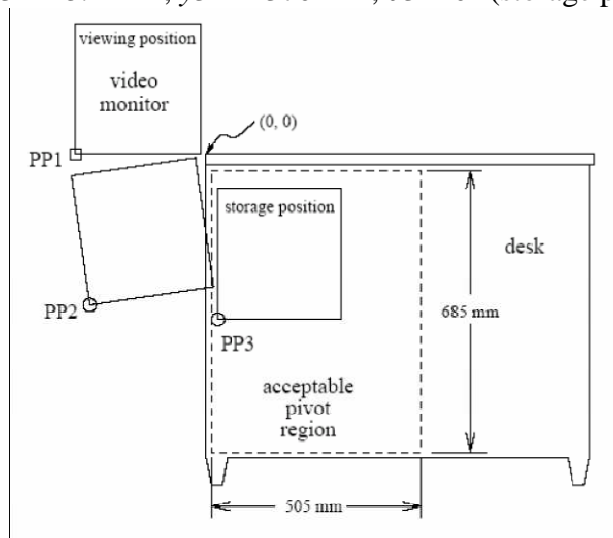


Figure 1

Mechanism Synthesis

While evaluating different ideas we use the Grashoff rule to see or predict a successful idea that can satisfy the 3 point criteria given in the problem. On brainstorming about the topic we proposed 3 ways to construct the mechanism.

Crank- Slider Mechanism

Make a crank slider mechanism for tv motion. This alternative will allow user to control every move of the mechanism. In the ideal world, this idea would be perfect, but will require time, patience and design analysis process would be complicated.

Double – Crank Mechanism

This mechanism is composed of 4 bar links and was given by Grashoff law $S+L < p+q$. For this mechanism there is no neutral link. What is appealing for us in the double crank mechanism is that it is simple to design in compare of the slider- crank mechanism.

Selected Design

After hours of consideration we selected the crank-rocket system. A golden rule always has been that simple is better and that has been the deciding factor against the crank slider mechanism. In the crank slider mechanism there were many problems involved such as if using rails and clearance in the desk.

Mechanism Analysis

With the double crank mechanism selected for TV motion generation. We feel secure we can design and construct a prototype that fulfills the requirements of the three points. We used chapter 2 equations for analysis of velocity and acceleration and chapter 6 for graphically looking for grounds. The joint between the shortest link and the base oscillate and hence is called a crank. The other link oscillate as well, that is why it is called a double crank mechanism. The coupler in our mechanism will be the one that has the TV. In our design we didn't include an electronic component such as an actuator because of budget limits but if one wanted for the mechanism to be automatic, the actuator may be placed in any turning link, or any of the cranks.

The Grashof equation for analysis was $S + l < p + q$

$$215+260 < 227.5+252.5 \quad \text{type 1} \quad 475 < 480$$

$$S=215\text{mm} \quad P=252.5$$

$$L=260\text{mm} \quad Q=227.5\text{mm}$$

Paper Analysis

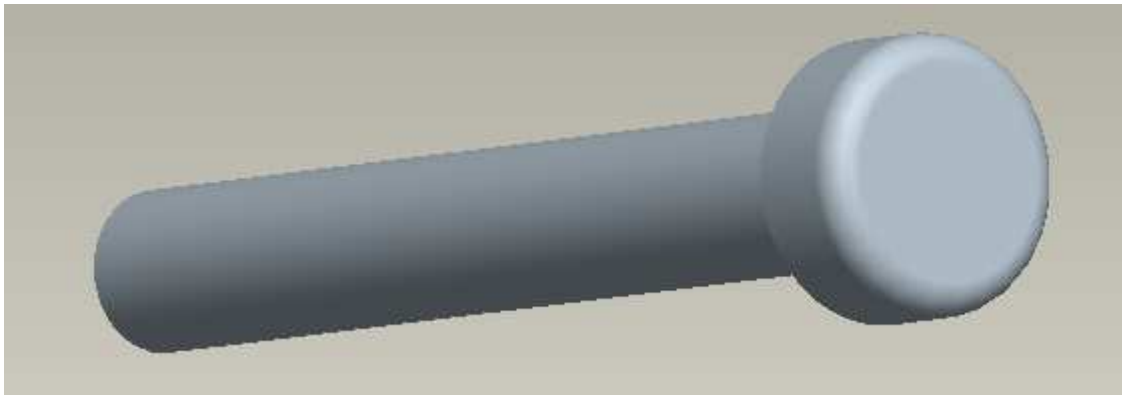
For obtaining the dimensions first it is necessary to obtain at least two points more for position one, two and three. Because it is not given those other points we can assume dimensions that are appropriate with limits the problem set us. We assume 2 points of the coupler and do image to obtain those two points in position two and position three. In our case we assumed three points and made a coupler with the three points. After having the 3 points in position one, two and three with help of bisectors (chapter 6) we are able to find 2 grounds that can make the mechanism work. Now what is left is to draw a line from any ground to the point the ground was designed and with a scale take the dimensions. In our analysis we took 2 points for designing the grounds with bisectors, those points we are going to call point C and point b, hence the name of the grounds c^* and b^* (look coupler drawing) We have to remember that this is a topological analysis and we can make simplifications to the mechanism for easy assembly. In fact in our analysis the coupler could be simplify by a simple line BC.

Concept Demonstration Prototype

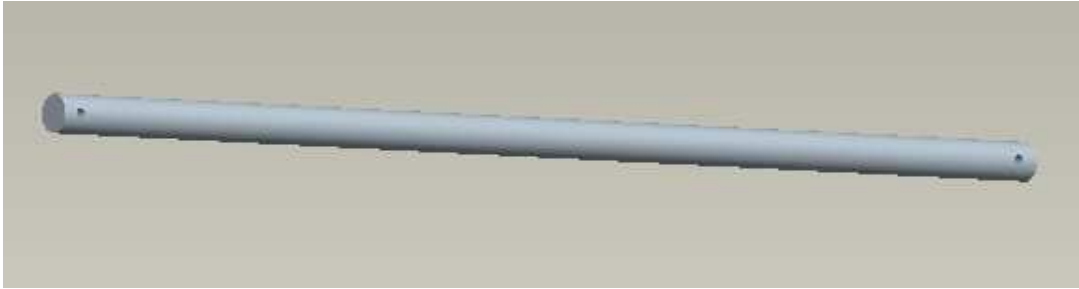
3-D Dimensional Model

To be able to create the mechanism it was necessary to visualize it first. To do this we use a CAD program, in our case Pro Engineer Wildfire. The model of the desk and the mechanism were created using the appropriated measurement. The measures were in millimeters and the scale use to create the real life model was 200 mm. = 10". There were some problems when the mechanism was going to be assembling the second ground had to be about a foot away from the top part of the desk. To solve this problem a piece of Word was cut and place has an extended piece of the desk his making this new point a ground.

Pictures of the 3-D Model



Screws (8 total)



Rods (2: 257.5 mm. and 260 mm.)

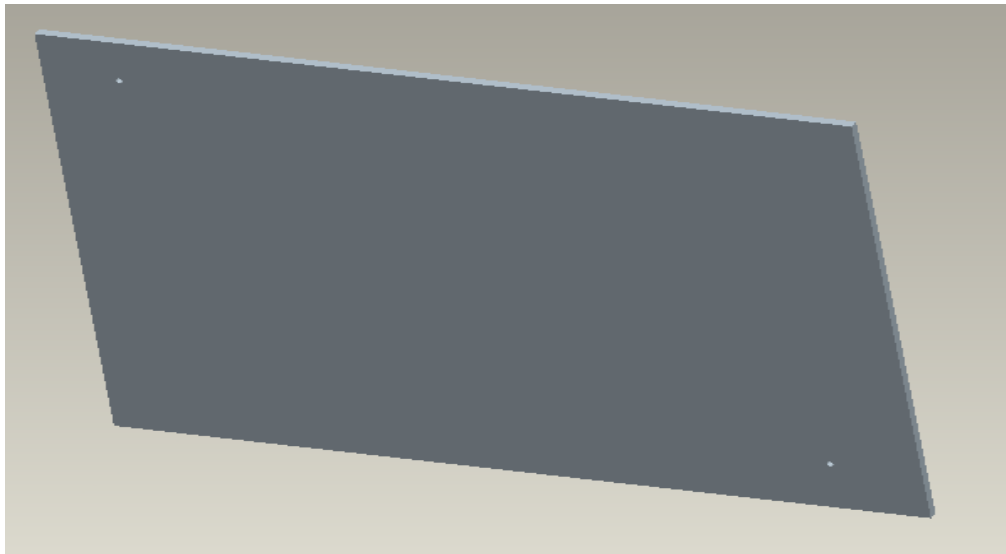
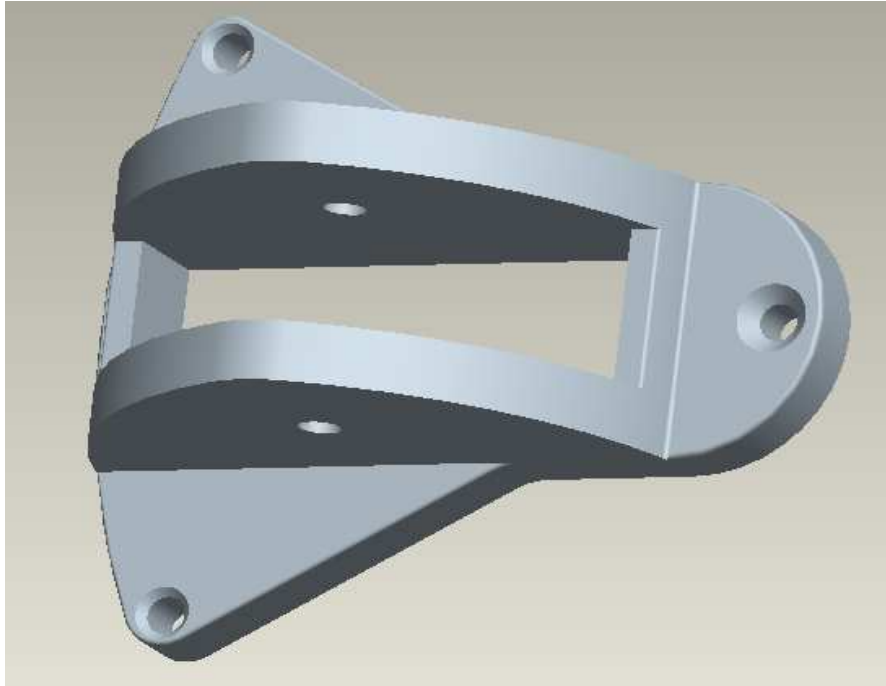
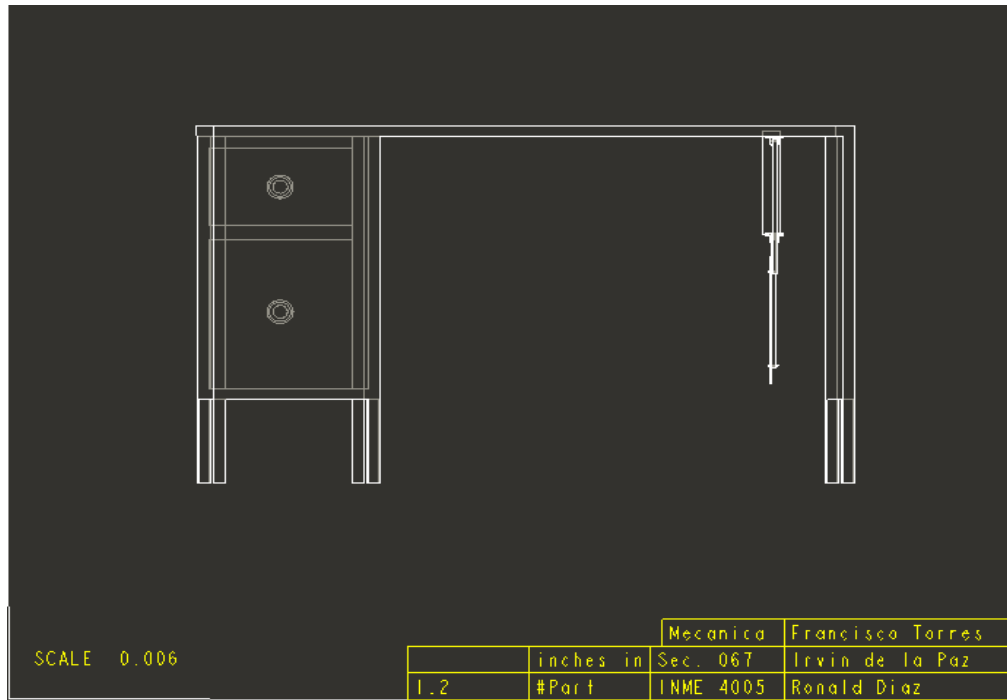


Plate (Support of the Television and Coupler)



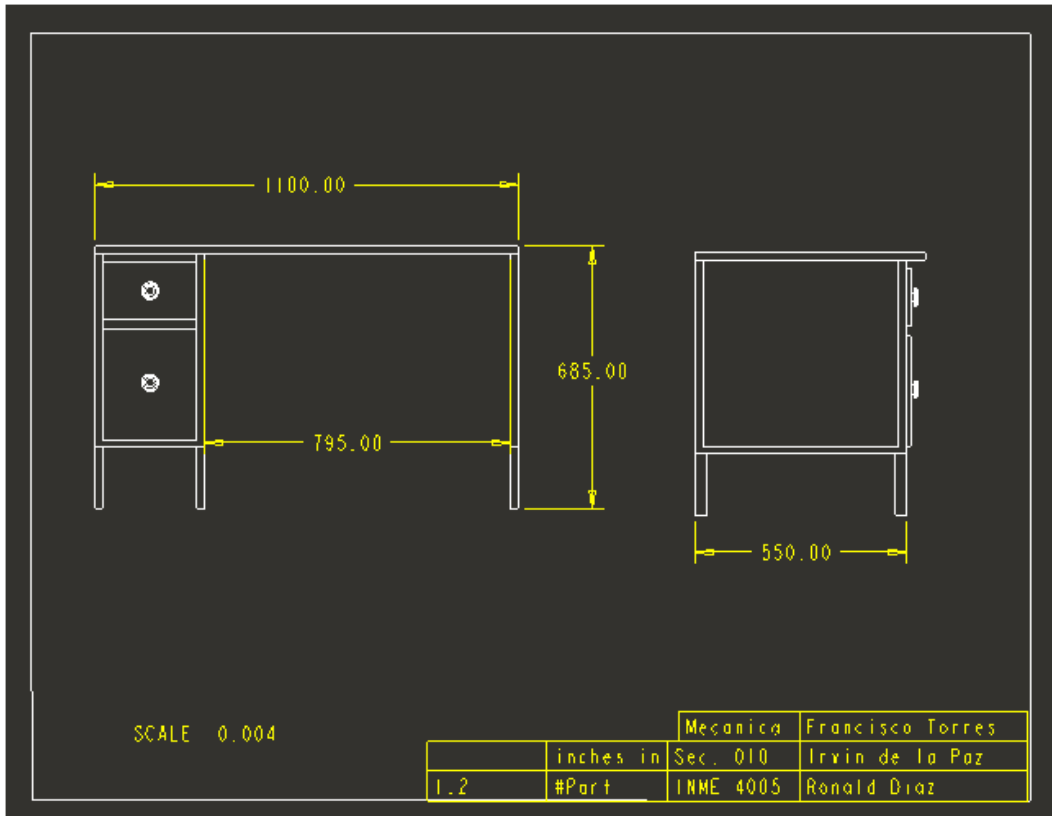
Base (2: supports of the mechanism, ground)



Assembly



3-D Assembly



Desk (Measures)



Final Product

Materials Used

Aluminum rods for links

As ground joints we modified 2 aluminum door holder/stop

Wood for the desk

Foam Board (simulating Monitor base)

We had a limiting budget and because of that we choose to represent the mechanism in the simplest cost effective way. The mechanism we constructed was

double crank. If we didn't had a limiting budget we would have assembled instead of one set of four bar link, 2 sets of four bar link where the coupler is the one that connect the 2 sets of 4 bar link, been the coupler the monitor base. Also we would have bought actuators to see the mechanism moving with a push of a button. We would have bought a metal plate and welded unto the coupler to make the monitor base. For our first prototype we feel proud as a team because we worked in group, exchanged ideas and presented what we thought was better. It was a fun project which everyone of us enjoyed doing.

References

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