Cartesian ARM

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Abstract - *In this research, whose objective is to design an arm with a mechanical system in which it intends to perform various movements such as lifting, transporting and placing a mold, for the operation of this arm a design will be elaborated with a piston that will work with a means of a hydraulic system, this to exert force so that the material can be molded under pressure, which gives strength to the arm and what allows a good movement in a stepper motor, the arm will have various sensors such as the inclination, which will make it made a better distribution through the planned path, as well as the ultrasonic will be used among others, these will help us to get a better control of the movements that it performs such as the angles of tilt, etc. This design will be carried out in Inventor which will be a detailed drawing of the mechanical and electrical part including everything mentioned above.*

1. INTRODUCTION

At present, technology has made great advances at an industrial level, companies have evolved their processes helping man with heavy work, and saving time, all this with the help of robotic arms. The main function of this project is to solve and facilitate the operation of a mechanism, putting into practice the knowledge acquired during the technical career. It is a theoretical-practical process where a structure of an arm with a piston is going to be elaborated to transfer a mold to a filling tank, it is proposed to result in a good mechanical operation with a good resistance where it is demonstrated both theoretical and practical that the materials used are adequate, with good resistance. This project allows us to know and improve the basic knowledge of mechanisms, we are in the process of developing technical improvements, work methodologies and continue with improvements, that allow us to design equipment of more efficient work.

2. THEORETICAL FRAMEWORK

The Robotic Arm is defined as the set of electromechanical elements that promote the movement of a terminal element (piston), either to fulfill a function or only to manipulate an object.

The system of a robotic arm is composed by a mechanical structure, transmissions, actuators and sensors. Its physical constitution is similar to the anatomy of the arms of a human being. There are four basic configurations for a robotic arm. The first is the cartesian configuration, consisting of three prismatic joints. The second configuration is the cylindrical one, which has two prismatic joints and one of rotation. The third configuration polar or spherical is formed by two rotational joints and a prismatic one. Finally, the angular configuration has three rotational joints (Ollero, 2001).

Coordinates are parameters that describe the configuration of a system with respect to another, used as a reference (Mason, n.d.). In the study of the direct and inverse kinematic models of a robotic arm, they are the coordinates (x, y, z) with respect to the reference system usually located at the base of the robot. *[2]*

Robots are designed to perform a specific task, which can be performed through their movements, that can be divided into two movements of arm and body. Each of the independent movements are capable of making a joint that is called the rank of liberty, for example, down-up, left-right. A rank of liberty indicates longitudinal movement or rotation.

The following drawing shows an example of an arm with linear joints, with three degrees of liberty, left-right, up-down, and back-forward. *[1]*

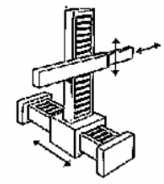

Figure 1 Linear joints

The joints used in the design of robots usually involve a relative movement of the adjoining joints, movement that is linear or rotational.

Lineal rotations involve sliding or translational movements of the connecting joints. *[1]*

3. DEVELOPMENT

3.1HORIZONTAL BASE

The base has a longitudinal length of 920 mm. It has two 10mm wide supports, where the spindle and the smooth

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rods will go, the third support will load the stepper motor. The 900mm will be the travel space.

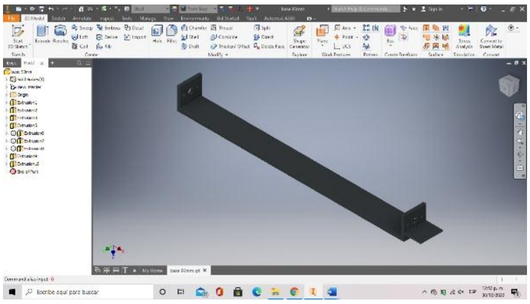

Figure 2 horizontal base

The following section describes the Cartesian arm design, which includes its characteristics and anatomy. It exposed in more detail technical and implementation aspects that will be used for construction.

3.2 PAP MOTOR (STEP BY STEP)

Controlled by a series of electrical impulses, these impulses cause angular displacements of 1.8 degrees associated with the number of movements or steps. This motor has the advantages of precision and repeatability in terms of positioning. This is a unipolar motor, made up of 5 or 6 cables, one of which is common to the power supply and the rest are connected to the device that controls the rotation.

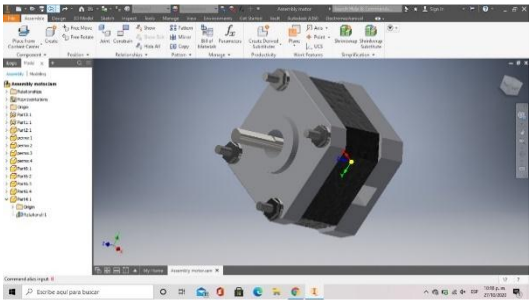

Figure 3 PAP Motor

3.3 RIGID BALL BEARING 608-2Z

This mechanical element has the function of reducing friction between the shafts and the parts associated with these shafts by means of rolling. The bearings serve as support and facilitate movements.

Rigid ball bearings are multi-purpose, self-retaining bearings with solid inner and outer rings and ball crowns.

These bearings, of simple arrangement are very resistant during operation.

With a dynamic radial load capacity of 3500N and static load of 1370N, limiting speed of 40000 1 / min.

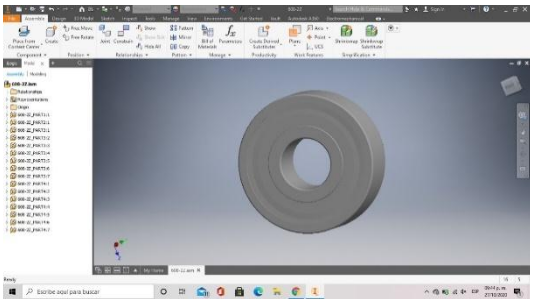

Figure 4 608-2z Bearing

3.4 COPLE

Coupling is the simplest way to achieve this transmission since it operates by joining the ends of said shafts, thus transmitting the rotation from one to the other. A good resolution of said transmission depends not only on the correct operation of the equipment, but also the useful life of the PAP motor. Aluminum slotted flexible coupling, model afp 6508 with a maximum speed of 8,000 rpm.

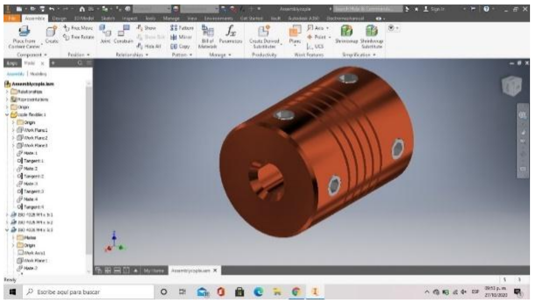

Figure 5 Cople afp

3.5 TRAPEZOIDAL SPINDLE

Responsible for producing the linear displacement, with measures of 8mm in diameter, and 500 mm long and another of 1000 mm.

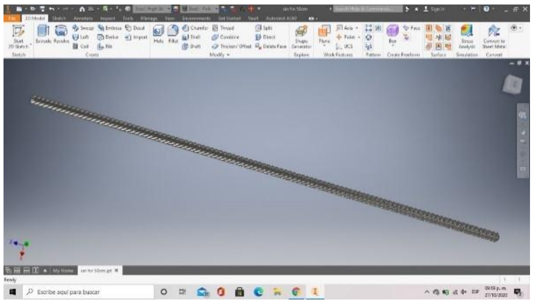

Figure 6, 8mm Spindle

3.6 HORIZONTAL BASE ASSEMBLY.

Two 608-2z deep groove ball bearings, two plain rods, a spindle, a coupling and a stepper motor are used for horizontal assembly.

The pap motor will be joined to the spindle by means of the coupling, this will allow the vertical base to achieve the stroke from left to right, where it will have 900mm of stroke.

The motor has an increment of 1.8 ° where it will take 200 steps to achieve the advance of 8mm.

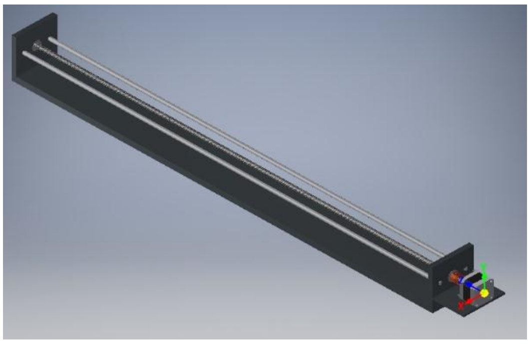

Figure 7 Horizontal base ensamble

3.7 VERTICAL BASE

The design allows the assembly on the horizontal base. It has a height of 498mm. The design allows the 400mm of stroke.

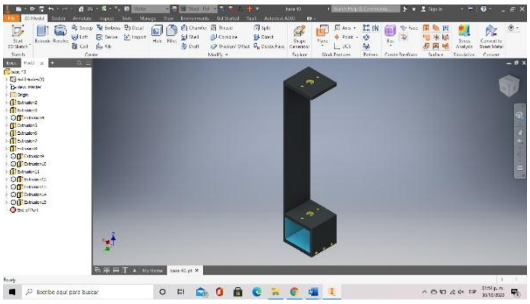

Figure 8 Vertical base

3.8 VERTICAL BASE ASSEMBLY

For the vertical assembly, two 608-2z deep groove ball bearings, two smooth rods, a spindle, a coupling and a stepper motor are used, then it will be assembled on the horizontal base.

The pap motor will be attached to the spindle through the coupling, this will allow the piston support the travel from top to bottom, where it will have 400mm of stroke.

The motor has a 1.8 ° increment where it will take 200 steps to achieve the 8mm advance.

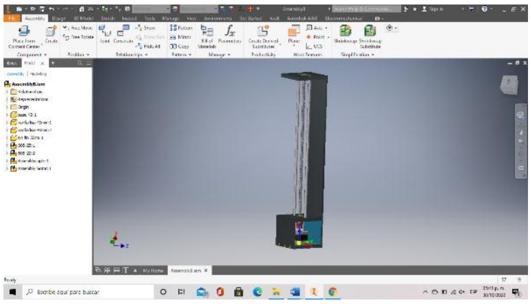

Figure 9 Vertical base assembly

3.9 PISTON SUPPORT

It is designed to be assembled on the vertical base, to make the travel from top to bottom of 400mm.

The piston will go into the blue tube. In this way, it will be able to stay in a rigid position so that it can be moved up and down.

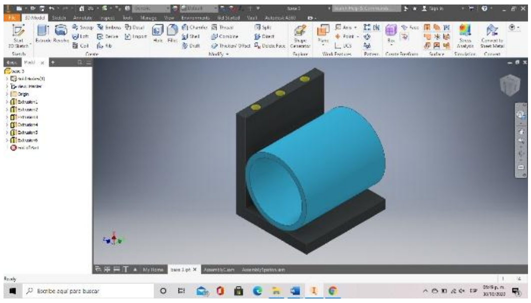

Figure 10 Piston support

The piston will fulfill the function of giving the necessary pressure to mold the soap.

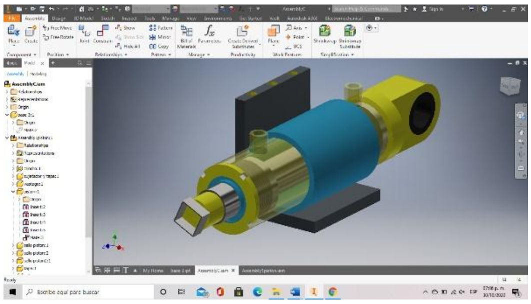

Figura 11 Piston support assembly

3.10 DOUBLE ACTING HYDRAULIC CYLINDER

Generation of force in both directions with hydraulic pressure, it has a high return force because it is hydraulic.

The piston already has an integrated mold that will shape the material.

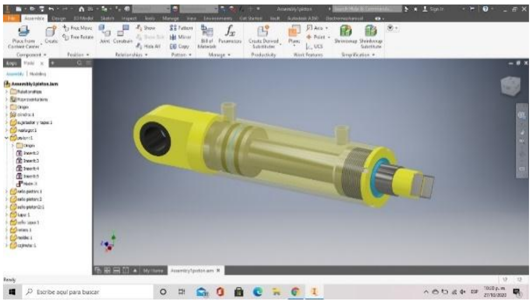

Figura 12 Piston with mold

4. RESULTS

When the motor shaft makes one complete turn the vertical base advances 8mm.

The motor shaft makes 112.5 turns so that the vertical base reaches the other end of the horizontal base.

During the run, the motor pauses for 10 milliseconds for each turn that the shaft completes. When the vertical base reaches the opposite end of the output, it pauses for 2 seconds.

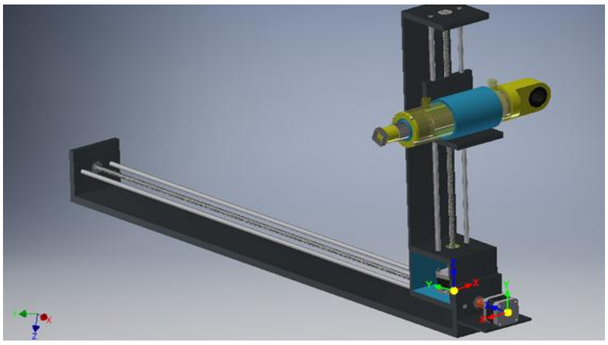

Figure 13 Start of stroke

To return to the starting point, the motor shaft makes 112.5 turns with pauses of 10 milliseconds for each turn of the shaft. When it reaches the starting point, the motor pauses for 2 seconds and the route repeats itself.

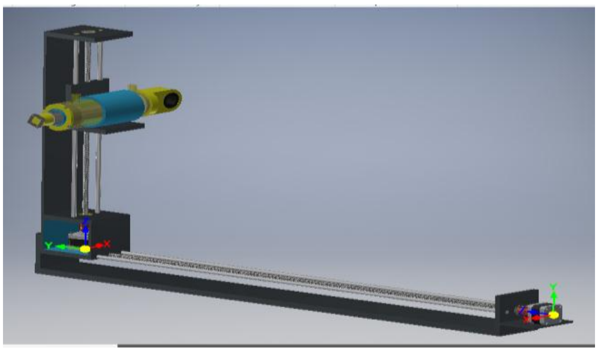

Figure 14 End of stroke

The motor shaft 50 turns so that the piston support reaches the top, between each turn there is a pause of 10 milliseconds, when it reaches the top the motor pauses for 2 seconds.

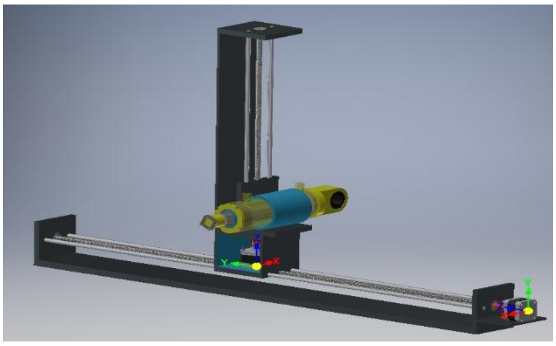

Figure 15 start of stroke of piston support

At the end of the pause, the motor shaft makes 50 turns again to reach the bottom where it pauses for 2 seconds and repeats the cycle again.

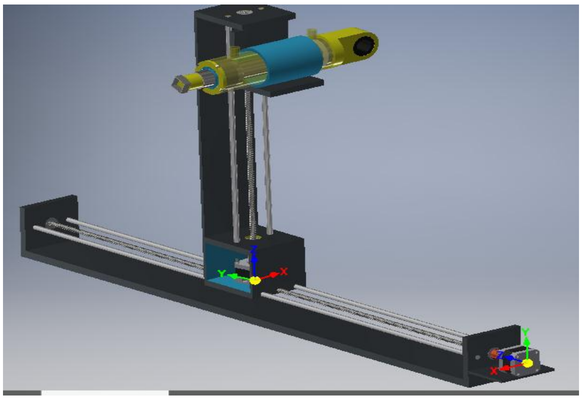

Figure 16 piston support end of stroke

When the piston is actuated, it travels 100mm and then returns to its point of origin.

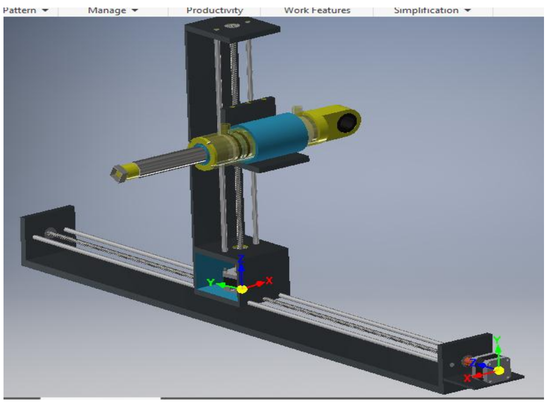

Figure 17 Piston drive

5. CONCLUSIONS

Through Autodesk Inventor software, it was possible to develop the design of a Cartesian arm, where it is possible to have 3 degrees of liberty.

The design of a pap motor was used to give motion to the X and Z axes to achieve the vertical base stroke and the piston support.

For the z axis, a hydraulic piston was designed that, when actuated, makes the 100mm stroke, complying with the three degrees of liberty.

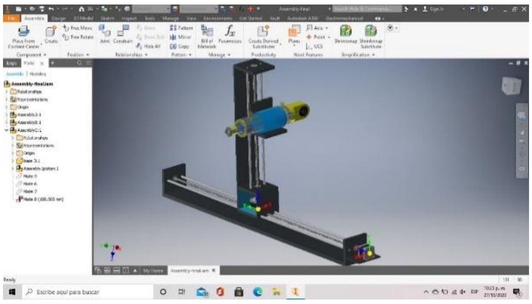

Figura 18 Final assembly

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