SOUTH ASIAN INSTITUTE OF TECHNOLOGY AND MEDICINE (SAITM)
FACULTY OF ENGINEERING
DEPARTMENT OF MECHATRONICS ENGINEERING

ME104 Praxis I

Project Proposal

Robotic Gripper Arm

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ABSTRACT

The objective of this project is to utilize a robot arm to pick up a metal circular ring from one place and move it to a particular spot. The gripper is made from a simple 1st order lever mechanism that involves the effort to one point and the outcome to the far end, which is the gripper. The robot arm will work based on the principles of hydrostatics utilizing the power of pressure to achieve the required goal. A simple system consisting of syringes and silicon tubes was used to create a robot which can move in 3D space.

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INTRODUCTION

Background

A robot is a simple machine that is programmed by a user to accomplish a certain task. Typically these tasks are labor intensive but have a tendency to be very repetitive and often times require minimum skill. Even though more advanced robots execute complex tasks some of the most basic ones are used for tasks which might be dirty, laborious or dangerous for a human to perform. Some advantages robots have over humans in the ability of doing a specific task indefinitely without the need for a rest or wage. Under proper maintenance a robot may function exactly according to its initial programming without losing precision or efficiency.

Current Project

The project consists of a simple robot arm that has the ability of grabbing a certain object (an aluminum ring) and maneuvering into a particular position where it drops the ring onto a stationery post. The operation of the robot arm is achieved using syringes and silicon tubes which transfer the required forces to operate the intricate motions of the actuators. For the free motion of the arm we choose to use a shoulder joint, followed by an elbow and finally a gripper which acts as a simple 1^{st} order lever.

GOALS AND OBJECTIVES

The project requires building a sturdy structure in which the robot can rotate about. The structure will consist of laminated cardboard cut in strategic shapes to offer strength while enabling full mobility. The cardboard is joined using bolts to create the required joints for the operation in the up and down (Y axis). A second joint is created near the base structure which enables the arm to grab objects located in the depth axis or z axis. The joints require work to be done in a single direction while the other works under passive gravitational forces which bring the system back to its initial state.

The main design goals are

- Designing a gripper system to open and shut with the operation of the syringe
- Manufacturing a sturdy base for the robotic arm to revolve around, the mechanism used for revolving should also be created.
- Designing a simple 4 syringe system to operate the robot in the xyz axis plus the gripper action
- Ensuring a good grip in the main gripping system for maximum lifting efficiency
- Obtaining the correct parent syringe to child syringe ratio for the most efficient use of force and displacement
- Since the controller of the robot should be stationery the required connections of the actuator must be positioned for maximum reach ability

OBJECTIVES

The main objective of this task to grab a certain object placed within 30cm of the robots base and to maneuver the said object to a post where it is to be released. The arm should have the required specifications in order to lift an object weighing roughly 75-100g with a diameter of 12c

MATERIALS

- Laminated Cardboard sheets/Plywood
- Fasteners and Bolts
- Rubber Bands
- Silicon Tubes (Saline tubes)
- Syringes
- Gripper pads (simple rubber material)
- Elbow Grease (not mandatory)

DESIGN AND FUNCTION

The core mechanism of this system is based on Pascal's Law which states that in an uncompressible fluid the pressure of the system remains constant when a force is applied to the extremity of the system. This change is felt equally throughout the system.

$$F1/A1 = F2/A2$$

Using this basic principle and the mass flow rate syringes can be combined using silicon tubes to obtain;

- 1:1 for equal displacements with a mechanical advantage of 1 which work using the same sized syringes
- 2:1 for half displacement with a mechanical advantage of 2 which work using syringes of relative size of 0.5

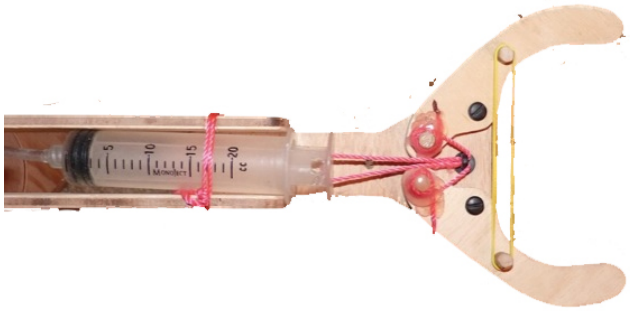
Syringes of the same size can be used to operate the simple functions of the robot and syringes of varying sizes can be used to control work intensive functions.

OPERATION AND MOBILITY

The robotic arm is expected to move completely using the inward and outward movement of the syringes under hydraulic pressure. The Degrees of Freedom that can be obtained using this system are marked in the following diagram

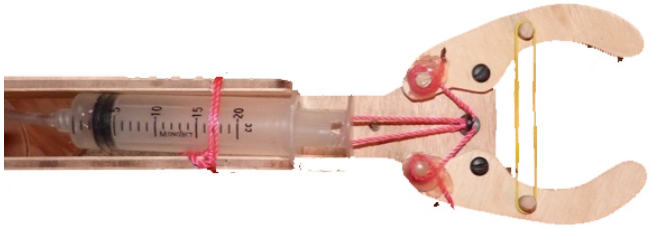
GRIPPER ACTION

The gripper works in the form of a 1st order lever. The function of the syringe is used to open the jaws of the gripper and the potential energy stored in the rubber band is utilized to bring it back to its original position.

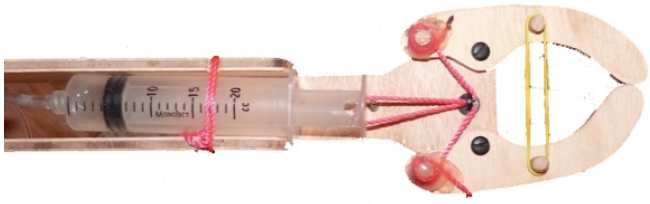


Open position

When the contents of the syringe are expelled/sucked the force generated opens both prongs



As the contents of the syringe are pumped back into the system the gripper returns back to it's closed position due to the action of the rubber band.



CONTROLLER OPERATION

Four syringes are used for the control and maneuvering of the robot arm. A single syringe is dedicated to gripping while the rest are used for positioning the system. The syringes are filled with a fluid, ideally water for the transmission of force to the gripper components.

TIME ALLOCATION

Activity	Session 1	Session 2	Session 3
Planning the project Propsal	X		
Creating the module(Sketching blue prints)		X	
Manufacturing the basic building blocks		X	
Assembling the final mechanism		X	
Testing the mechanism and function		X	
Demonstrating and Evaluation			X

BUDGET

Item	***Quantity***	***Price***
Syringes	6 x 40/=	240/=
Laminated Cardboard	500cm2	200/=
Rubber Bands	Single Pack	50/=
BBQ sticks	Single Pack	50/=
Silicon Tubes	5 x 20/=	100/=
Fasteners and Bolts	20 x 10/=	200/=
	Total	840/=