Industry Projects Submission 1

ME 639 - Introduction to Robotics

IIT Gandhinagar

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We attest to abide by the stated collaboration policy: We understand that all sorts of collaboration are allowed, however, plagiarism will not be tolerated. If we use material from some other source (or from friends), we will cite them appropriately.

Automatic Loading and Unloading of Manifolds

Statement of Our Understanding of the Project

The horizontal Machining Center (HMC) has a horizontal spindle (parallel to the ground). It takes much time to change the parts manually and stops the whole machining process for a while. So the horizontal machining center uses automated pallets and tools, which reduces the time for the setting up process. In our problem statement, the workpiece is manifold. For understanding, consider the manifold as a heavy metal cube. Initially, the manifold is on the ground or a certain platform. Now, we have to pick this heavy manifold and place it on the working place of the Horizontal Machining Center, this will be our Loading part. For the Unloading, we need to pick the manifold from the workspace of HMC and place it on a certain platform which can be the same as initial or different, depends on the requirement. After loading the HMC tool will do the work on the manifold. This action is preprogrammed and it does not care whether the manifold is placed correctly or not. Thus it becomes very important to do loading and unloading precisely with zero accuracies. Doing this task by using manpower causes an error. Thus we have to design a robot that can load and unload manifolds on pallets efficiently. It has to be precise, fast, and power-efficient.

Tentative Approach and Tools we May Need to Use

A 3 DOF or more robotic arm can pick and place manifolds from one location to another on a given 3D workspace. What robotic arm is to be used depends on the constraints available. We may use a gripper end effector to hold the manifolds. We will derive all the necessary mathematical equations and write a python code for robotic arm manipulation.

Key Assumptions Made in Approaching the Problem

1. No orientation constraints to the end-effector on picking of manifolds.
2. There is no singularity constraint in the workspace.
3. There is no constraint on the trajectory of the end-effector(such as obstacles).

Key Questions to Clarify the Requirement of the Project

1. Weight and dimension range of manifolds and Horizontal Machining Centre(HMC).
2. The duration in which the loading/loading of a unit should take by the manipulator.
3. The workspace of the robotic arm and its position relative to the HMC.
4. The expected size of the robot.

Expected list of Deliverables

- ☑ ~~A brief explanation of the concept (including type of robot, number of links and joints, and other such details~~
- ☑ ~~Figures/drawings/sketches showing the concept~~
- ☑ ~~Relevant equations of the robotics solution~~
- ☑ ~~Codes incorporating the solution~~
- ☑ ~~Representative plots/or other representative results from the codes~~
- ☑ ~~CAD drawings~~
- ☑ ~~Explanation of the solution and the results~~
- ☑ ~~Statement about limitations and future recommendations~~
- ☑ ~~Others (list as many as needed)~~
  - ☑ ~~-Other applications_____~~
  - ☐ _____
  - ☐ _____

A Highly Tentative Sketch of the Problem and Expected Solution

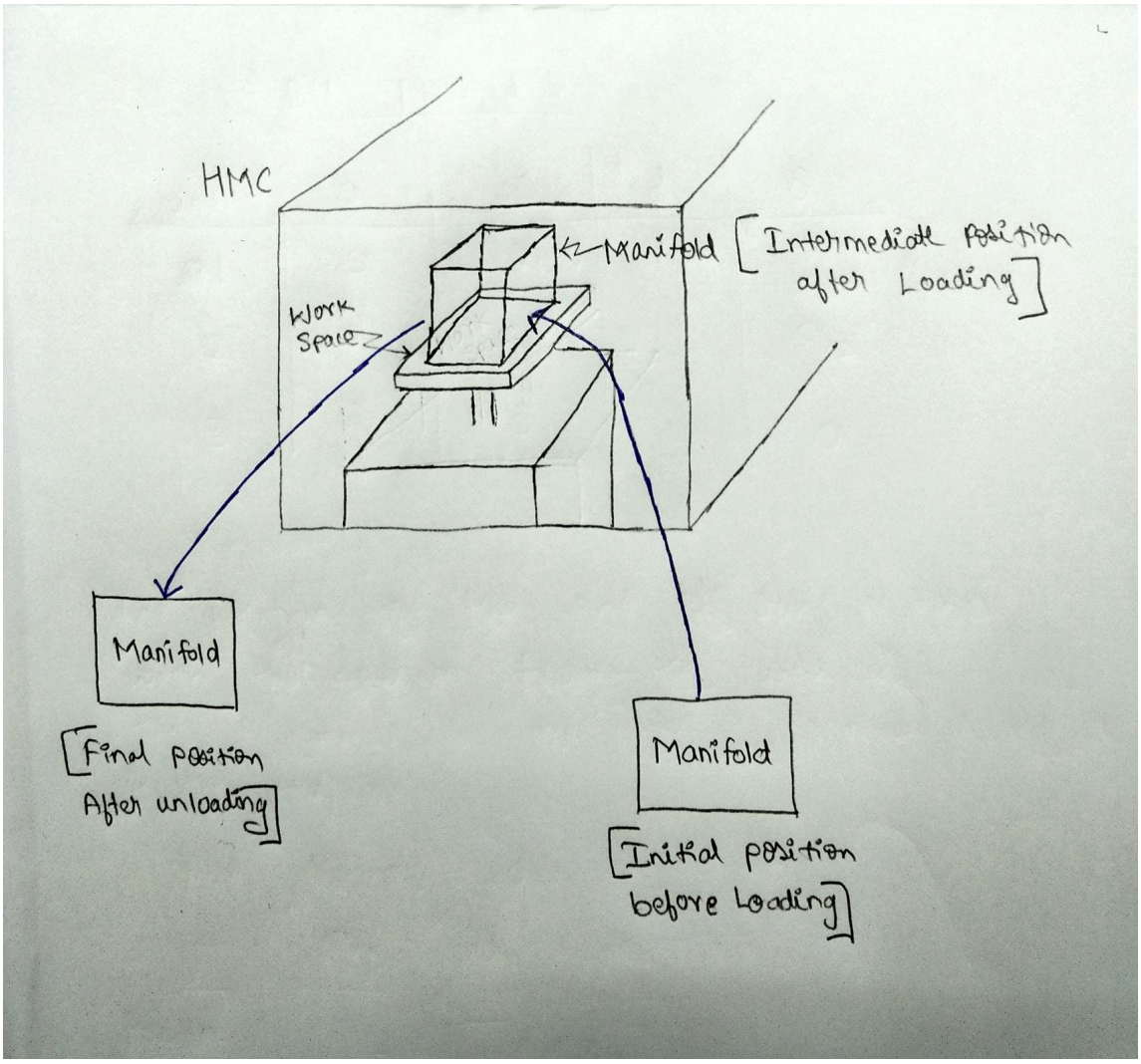

Fig 1.: Tentative Sketch of the Problem

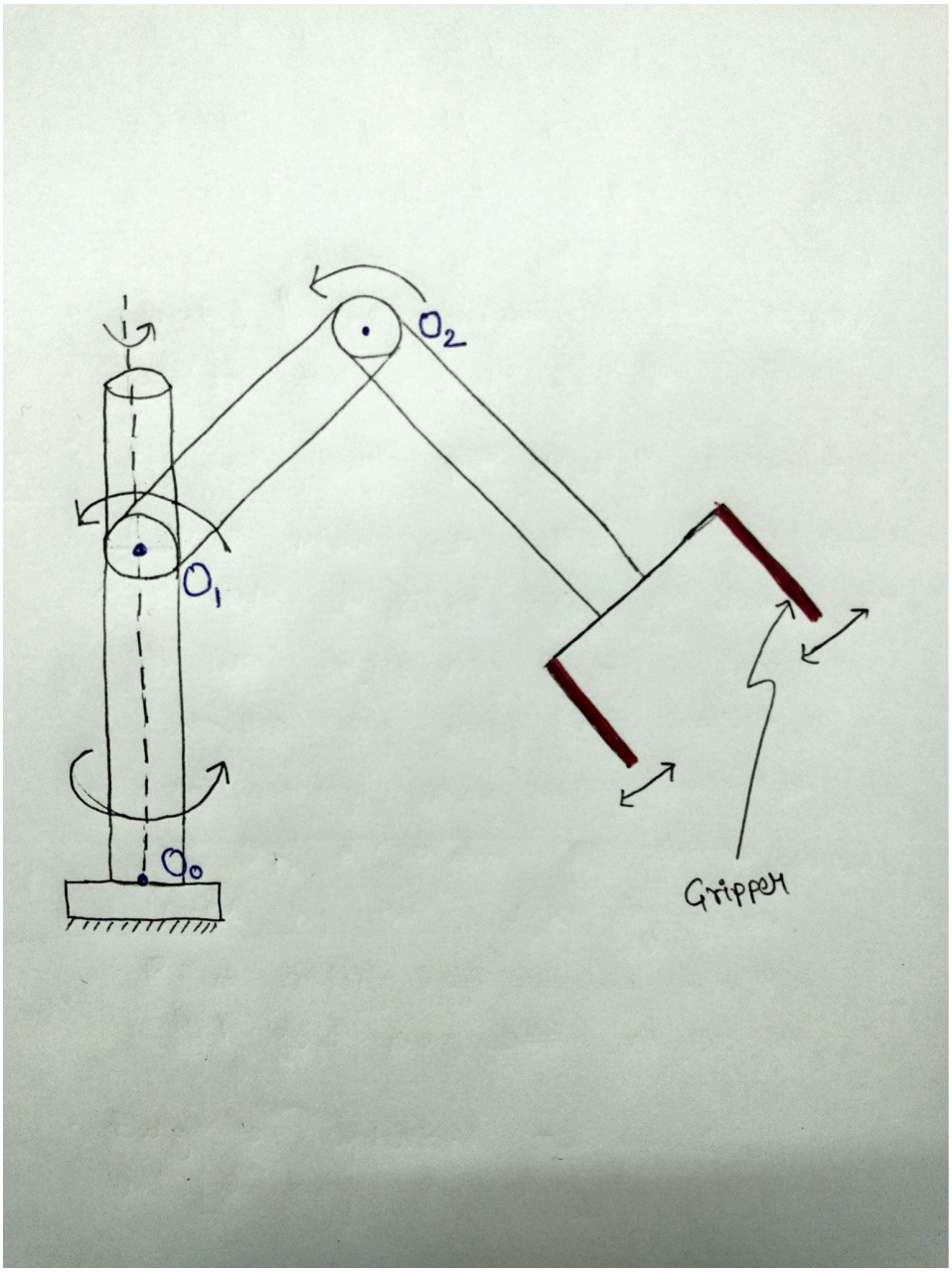

Fig 2.: Tentative Sketch of Expected solution