* Figure out if motors will be able to move the robot. Make estimate of weight and see which motor specs do we need.

Motor Specs

Due to the nature of the task, the end-effector is required to have a high range of motion while also being highly precise. The implication of these requirements is that the mechanical build of the robot arm will need to be rather extensive, and in effect, could be of considerable weight. Given that the mechanical build could be rather heavy, it is pertinent to consider motor specs required to move the machine.

The most pressing concern is specs required to facilitate movement along first dimension of motion (the length of the table most likely) as this will require being able to move the entire weight of the machine. For our purposes we will use a liberal estimate of 250 kg for the mass of the robot. We will likely be using some form of slide bearing to aid movement of the machine along the first dimension of motion. We will therefore use an estimate of 0.3 for coefficient of static friction (mu). This is, again, a very liberal estimate as coefficient of static friction for slide bearings can vary anywhere from approximately 0.003 to 0.3. Using the mass of the robot and the coefficient of static friction, we find that a force of 250\*9.81\*0.3 = 735.75 N is required to move the machine along the first dimension of motion.

While 735.75 N is a rather high value, it is not entirely unfeasible. It is possible to purchase stepper motors rated for 50 N-m stall torque. This translates to 735.75 N of force at roughly a 6.8 cm effective radius (radius to translate motor rotation to linear motion). As it is likely that we will be using an even smaller radius for this purpose, 6.8 cm is a perfectly acceptable metric. If for some reason a 50 N-m motor is found to be unfeasible it is possible to use multiple motors of lesser capability, two 25 N-m motors for example. Furthermore, intelligent planning with regards to the design of the robot arm could result in a total weight much less than 250kg and the use of high quality slide bearings could result in a coefficient of static friction orders of magnitude less than 0.3. Both of these factors would work to reduce the required stall torque of the motors.

* Adequate emergency shut-off controls.

Emergency Shut-off

Given that the robot arm of the system is likely to be quite heavy, the motors used to drive the machine will be required to be rated for high torque. High torque components such as these pose a serious safety hazard as loose material may become trapped in the moving parts and may be unable to be pulled free. It is therefore important that an individual operating the mechanism or otherwise interacting with the system should be able to kill power to the machine at any time during which high torque components may pose a threat to that individual.

For this requirement to be met, a viable solution is to design the system such that accessible emergency shutoff controls be located on all moving parts which operate with high torque. In this way, if at any given time an individual operating the system is to become trapped by the moving components, an emergency shutoff control is guaranteed to be within reach. Furthermore, it would be prudent to place backup emergency shutoff controls at regular intervals along the edge of the pool table. The intention being that for all possible configurations of the robot arm at least one primary shutoff control on the mechanism and one backup shutoff control on the table be within reach if an individual operating the system is to become trapped by the moving components.