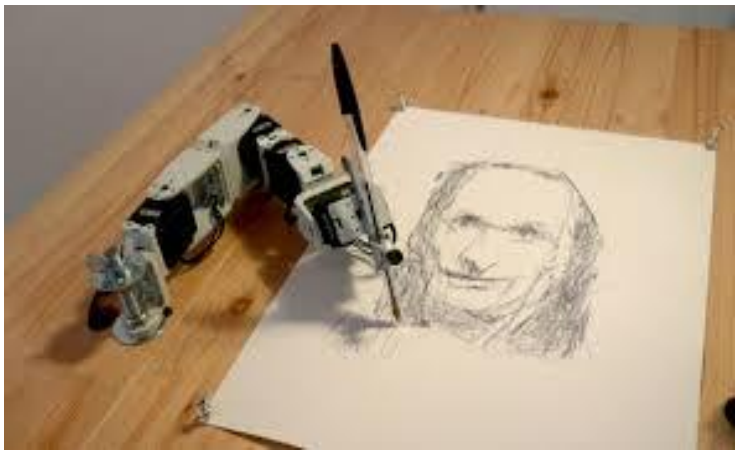
TITLE : MECHANICAL HUMANOID ARM TO CREATE MOCOCHROME SKETCHES COMPOSED OF LINES AND POINTS WHERE PICTURE TO BE DRAWN IS UPLOADED TO IT VIA A PC.

AIM In this generation we are witnessing a huge demand for robotics and it has become an industry with a huge potential in engineering and related applications. Huge amount of research is going on to create robots similar to human, which closely mimic human movements and locomotion. Hence our project is a stepping stone into this world. Currently we would use this to create sketches but the same design can be modified to render it useful for a plethora of other jobs.

PICTURE



(For illustration purposes only, actual product may differ slightly)

FEATURES AND ROUGH TIMELINE

In our project we create a robotic arm to make sketches (consisting of lines and points only).
The arm will move in a plane and will be made of 2 members.
It will have 2 degrees of freedom, one for rotation of ' shoulder ' and the other for rotation of 'elbow'. Moreover in the ' wrist ' we will attach a solenoid coil to move the pen up or down.
The main steps in our project are as follows.

1.) (**2 weeks + time we manage to save from coding and microcontroller**) Creation of frame of 2 member mechanical arm with a 'wrist' to hold pen.
2.) (**1 week + 1 month during MAY, we will create the main program to read and process the picture when we are not here in MAY, so that on arrival, we just have to modify our output according to the microcontroller's requirement**.) Writing a program to decompose a sketch/picture into a set of lines and points and feed it to the microcontroller.
3.) (**1 week + we will read up about the microcontroller in advance before coming [i have a book], to save learning time.**) Choosing appropriate microcontroller and programming (after learning) it to read instructions given to it and control the parts of the arm accordingly. (Rotate servos accordingly to achieve required displacement and rotation of arm and to move the pen up or down).

P.S. During orientation, mentors suggested that this model is feasible and hence we proceeded with this idea. However if it turns out to be too difficult, we will tone down the project accord-

ingly after consultation with mentors. Moreover we have also been permitted to an extra time of up to a week, if needed, due to our unavoidable late start. (I stay here, room isn't a problem for me) We will do our best to finish it in time and try not to use the extra time.

PRIMARY DIFFICULTIES/ OBSTACLES

1.) The arm has to make precise and accurate movements which are bound to get error prone as we have two degrees of freedom. The joints are not rigid and hence some random movements may occur. This brings in its own set of backlash errors as the joint of the members may be jittery no matter how precisely we do the drilling. Moreover the motors may also have backlash errors.

So we plan to introduce the concept of **parallel kinematics** wherein the net error introduced in the system may be less than the errors of the members themselves.

But this would mean an extra set of members to be added to the system that may increase the weight of the arm itself. So this problem demands either of the solutions specified below:

(1) Excellent fabrication of joints by 3D printing or cutting with high pressure water jet to exact specifications.
(2) Attachment of a free wheel to both the joints so as to facilitate easy movement.
(3) Regular checking of angles between arm parts by a potentiometer (regularly calibrated) to Make necessary adjustments in case of any errors.

2.) To develop a good algorithm to convert simple monochrome pictures into a set of lines (straight or curved) and points. This program is to be used by a PC to convert the pictures and the output created will be sent to the microcontroller thereafter.

3.) Precision of the motors themselves is important apart from reduction of random errors in the arm. The actuators used in the arm have to be precisely rotated and their rotations have to be tracked to reduce any errors. Moreover the least angle of turn of each actuator has to be minimised to draw 'smooth' lines. As of now we have thought of fitting the actuators with gears of varying sizes, which will decrease the least angle of rotation with increase in torque.

PRIMARY COMPONENTS AND ROUGH (MAXIMUM POSSIBLE) PRICE

1.) Arduino (or equivalent micro controller) (< Rs 3000)
2.) Frame of arm to be made of acrylic, plastic (may be 3D printed or cut / drilled with water jets)(?)
3.) 2 servos for rotation of 2 joints. (< Rs 1500)
4.) 1 solenoid coil for pen up/down (Rs 200)
5.) Jumper wires (Rs 50)
6.) Circuit board / breadboard, solder (< Rs 500)
7.) Wooden table (to fix arm to it and to keep paper) (< Rs 500)

TEAM MEMBERS

1.) ARITRA LAHIRI 13D100009
2.) AJAYKUMAR 130100091
3.) SIDDHANT RANADE 130260002

WHAT DO WE LEARN

1.) Image processing. Converting relatively simple monochrome images into a series of lines and points by developing an effective algorithm. Coding motion of arm according to set of lines and points generated.
2.) Making and controlling a robotic arm and the kinematics associated with it (forward and inverse kinematics). Since sketching is a delicate thing, we will learn a lot about practical controlling.
3.) Tackling common difficulties such as random errors, jittery movements arising from non rigid joints, sagging under stress of the arm, by using parallel kinematics, modern fabrication techniques, regular electronic checking of parameters.
4.) Hard Work obviously!