RESEARCH ARTICLE OPEN ACCESS

The 2D Plotter

Prachita Upate[1], Pooja Wankhede[2], Prof. C. D. Raut[3]
1((Electronics & Telecommunication Department,SRPCE, Nagpur, India.
2 ((Electronics & Telecommunication Department,SRPCE, Nagpur, India
3((Electronics & Telecommunication Department,SRPCE, Nagpur, India.

Abstract:

Huge numbers of the illustration applications, for example, Crafting, Animation, and so forth should be possible physically however it's extremely tedious, so the 2D Plotter robot is less tedious than manual process and this can be the answer for this. A servo motor uses Pulse width modulation from Arduino UNO micro-controller to know the situation for the development for its Cutter. The robot can move in both clockwise and anti-clockwise direction for plotting and cutting the picture. Servo motors are required to make support for ends. Caster wheels are required at the base of the arm with the cutter for appropriate adjust and support. Cutter can be connected to the servo motor using cloth-pin. The robot will draw the picture in view of changing the picture in MATLAB using canny edge detection. Cutting and plotting command given by MATLAB Simulink through UART protocol.

Keywords — **Arduino Uno Microcontroller, MATLAB, Servo Motor, ATmega328P, Image Processing, Canny Edge Detection, Inverse Kinematic Algorithm.**

I. INTRODUCTION

Utilizing this undertaking one can spare his/herself from embarrassment in crafting. This project gives adequate knowledge of Arduino, MATLAB Simulink for Arduino and mechanics. This project includes use of Inverse kinematics. Servos are little yet capable motors that can be utilized as a part of a large number of items going from toy helicopters to robots. In this project the utilization of Inverse kinematics is to decide the joint parameters that give a desired position to plotting the robot's arm. Servo motors are required to make support for finishes of robot. By inserting the picture in MATLAB which we need to plot and cut, robot will draw that picture.

II. LITERATURE SURVEY

There have been few examines on the human representation age framework. A few specialists have led the investigation of drawing robots. ZKM lab made the principal constant robot portraitist framework, in which a modern robot drew the face representation for the human sitting before the camera [1]. Switzerland LASA-EPFL research center built up the most entire cartography robot framework incorporating Fujitsu's humanoid robot HOAP-2 with another picture procedure innovation to draw the representation [2]. Reference [3] presents a conduct based robot control technique for brush drawing where differential development was embraced rather than traversal focuses. Reference [4] presents a 3 DOF robotic arm utilized for drawing on a paper sheet which is built utilizing LEGO NXT blocks. The examination in [2] plans to build up a human representation age framework that empowers the two-furnished humanoid robot, Pica,

to independently draw the face picture of the individual sitting before Pica. Betty, a picture drawing robot was created utilizing adjusted Theta-diagram, called Furthest Neighbour Theta-graph [6]. The diverse controlling strategies were connected in the expressed references. Some of them are excessively complex, some are costly, and some are broad, although each exploration attempted to locate the finest method to draw. We needed to make the robot free of multifaceted nature that is the reason we utilized 2 DOF arm. We attempted to give the robot a simple interface and degree to be adjusted effortlessly, that is the reason of utilizing Matlab.

III. SYSTEM DESIGN

A. WORKING PROCEDURE

The flowchart is given in Fig.1. Picture is taken input to the system through MATLAB. Picture can be obtained by a predefined way in PC. The taken picture is RGB, so the framework changes over the picture into gray-scale. At that point the gray-scale picture is changed over to a Binary picture by edge detection technique. Binary picture is nothing but the combination of white and black pixels. Matlab calculates the fundamental Inverse kinematics calculation taking Black pixel's organize position and sends joint plot for the servos to thecontroller. Arduino gets the joint angle through serial correspondence and controls the servos.

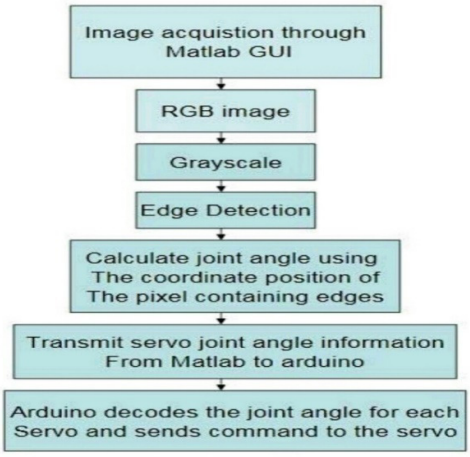

Figure.1. Programming Flowchart

B. ROBOT ARM

The outlined arm is essentially a 2 DOF planer robotic arm set on a wooden board. The arm comprises of two connections made of aluminum sheet, one servo mount, two servo motor and a pen holder as an end effector. An appropriate length of arm is kept up with the goal that it can draw on an A4 measure paper sheet. Here end effector is a pen holder appended with a servo motor.

During line drawing pen is kept down and after drawing a line pen is kept up.

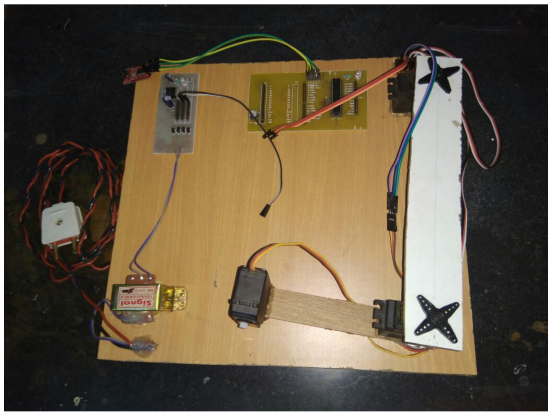

Figure .2. Robot Arm

C. MATLAB INTERFACING

MATLAB is an interactive programming framework for numerical calculations and designs. It is specially design for matrix Computations, solving system of linear equation. MATLAB has an expansive database of built in algorithm for image processing and PC vision applications. It gives numerous capacities to image processing and different undertakings. A large portion of these capacities are composed in MATLAB language and are publically readable that can be customized. MATLAB can compose serial information to serial port in various baud rate which are arduino readable. Serial communication amongst arduino and MATLAB is a considerable measure less demanding than some other framework. Because of these advantages we choose MATLAB for image processing and inverse kinematics calculation.

Because of simple access to the image representing matrix MATLAB makes it simple to apply the inverse kinematics totranslate the pixel organize data to the robot joint angle. There is another awesome part in MATLAB, which is Graphical User Interface (GUI). Graphical User Interface can be designed easily in MATLAB. GUI gives a user advantages to associate with the system architecture. Fig.3 is our design MATLAB GUI which has been utilized to give a picture as info. GUI has two input features, acquiring a picture from folder inside a PC.

D. ARDUINO UNO

Arduino is an open source physical computing platform in based on a basic I/O board and an development environment. The ATmega328P is a source of Arduino UNO microcontroller. For servo motor controlling Arduino UNO has been utilised. As a serial data Arduino gets joint angle data. After decoding the joint angle data arduino sends command to the servo, how much should it rotate.

Figure 3. Arduino UNO

E. SERVO MOTOR

Servo motor is an actuator that can be controlled correctly for linear or angular position. A servo motor comprises of electronic controller,feedback device and electric motor. Servo is expected to feed a signal pulse to rotate for a particular angle. We utilized servo motor which is high torque servo. To utilize the servo, firstly it needs to be calibrated. For 544us pulse servo remains at its zero position and for 2400us that servo remains at 180 degree position.

Figure.4.Servo Motor

IV. INVERSE KINEMATICS

Inverse kinematics is the technique for deciding the joint angle when the situation of the end effectors is known. In Robotic technology, inverse kinematics makes utilization of the kinematics conditions to decide the joint parameters that give a desired position to every one of the robot's end-effectors.

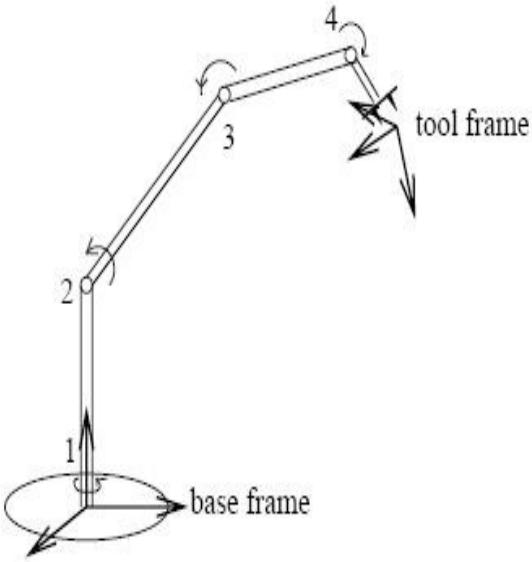

Figure.5. Inverse Kinematics

V. IMAGE PROCESSING AND CANNY EDGE DETECTION

Image Processing is one of the fundamental sections of the designed system. The input image is a RGB picture which a mix of a many shed that is too complex to understand for a robot. So we have to change over a RGB picture to gray-scale where different colour combinations are reduced to just black and white intensity. At that point gray-scale picture is changed over into a binary image. The way toward changing over a gray-scale picture into a binary image picture is performed by edge detection technique. Edge detection significantly reduces the amount of data and filters out useless information.

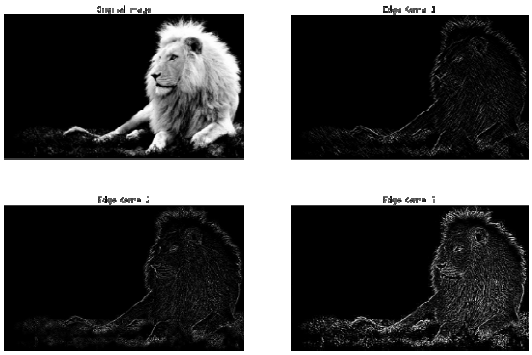

Figure.6.Canny Edge Detection

VI. CONCLUSION

In this paper we developed a robotic arm which can sketch human face with a 2 DOF robotic arm. Our research work will motivate the peoples about robots through an interesting behaviour of robot. Our designated system has few advantages such as,

- It is a cost effective, frugality of complexity and user friendly robot.
- Graphical User Interface gives user more interaction to control the robot.
- Capable of producing higher quality output depending on efficiency of edge detection.

Our designed robot has a versatile application in entertainment and educational purpose. It's a great fun to watch that a robot is sketching image. It's an inspiration to the general people to know about the robotic activities.

Our future research is to develop the drawing quality by increasing the edge detection efficiency. Our target is to modify the current edge detection method to get finest drawing with less possible amount of edges.

REFERENCE

1. *Sylvain Calinon, Julien Epiney and Aude Billard, "A Humanoid Robot Drawing Human Portraits", Ecole Polytechnique F´ed´erale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland.*

2. *Chyi-Yeu Lin, Li-Wen Chuang, Thi Thoa Mac, "Human Portrait Generation System for Robot Arm Drawing", 2009 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, Singapore, July 14-17, 2009.*

3. *Yang Junyou, Qiu Guilin, Ma Le, Bai Dianchun, Huang Xu, "Behaviorbased Control of Brush Drawing Robot", 2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE), Changchun, China, Dec. 2011.*

4. *A´kos Ha´mori, Ja´nos Lengyel, Barna Resko, "3DOF drawing robot using LEGO-NXT", 15th International Conference on Intelligent Engineering Systems, Slovakia, June 2011.*

5. *Meng Cheng Lau, Jacky Baltes, John Anderson and Stephane Durocher, "A Portrait Drawing Robot Using a Geometric Graph Approach: Furthest Neighbour Theta-Graphs".*

6. *Shunsuke Kudoh, Koichi Ogawara, Miti Ruchanurucks, Katsushi Ikeuchi, "Painting Robot with Multi-Fingered Hands and Stereo Vision", 2006 IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems, Germany, Sept. 2006.*