ERTS LAB

IIT-B

Vector Image extraction and Autonomous Duplication by Artist Arm

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1. Introduction

In industry there are requirements where human involvement is needed for drawing lines, welding sheets, drilling holes. If we can use a robot who knows exact plan of action, then robot itself will work on it and human interaction will reduce.

Artist Arm is project to design a program for Robotic Arm such that the object held in Arm-grip will plot the points of the image on a sheet of paper. This arm will be used for sketching vector drawings.

Artist Arm will be implemented using Dexter ER-2 Heavy Duty Robotic Arm.

2. Problem Statement

The problem statement was to capture images from a webcam and draw them on a sheet of paper with the help of the Dexter ER-2 Heavy Duty Robotic Arm. However, due to time constraints and problems related to the motors of the Robotic arm the scope of the project was reduced to plotting the outline of the image as points on the sheet of paper. The whole project will be open-source and the code is implemented using coding standards and standard naming conventions. The code of Visual Studio will be reusable, readable and portable.

3. Requirements

- Hardware Requirements

    - Dexter ER-2 Heavy Duty Robotic Arm

    - Webcam for Taking pictures

    - Interface to the Robotic Arm – Here we are using the GUI provided by Nex Robotics

- Software Requirements

    - Microsoft Visual Studio 2008

    - OpenCV2.1 for image acquisition and image processing

4. Implementation

Files and their descriptions

Filename	Purpose
AngleCalculation.h	Header file – Contains declarations of functions and variables used
Point.h	Defines a 2D point class
AngleCalculation.cpp	This file contains functions which when given a file with 2D points calculates the required motor angles to be set to take the artist arm to the required 2D point
Vector.cpp	Contains functions for dealing with images – Given the image, convert it into corresponding vector image and calculate the 2D points on paper corresponding to the coordinate system of Dexter ER-2 Robotic Arm

5. Testing Strategy and Data
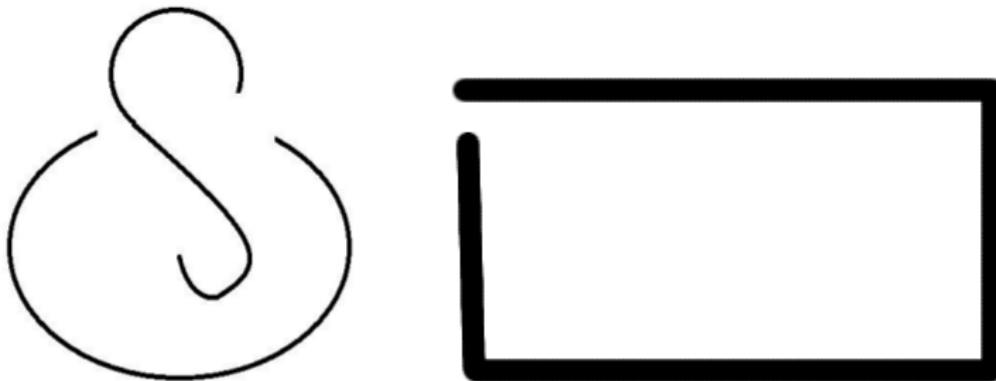
- We tried out various images as input to the program. The program first converts these images to vector images and calculates 2D points corresponding the

coordinate system of the Dexter ER-2 Robotic Arm. The coordinate system is mentioned in the manual of the Robotic arm.

5.1 Results

6. Discussion of System

The initial commitment for the project was to draw (duplicate) the given image on the paper. However, drawing strokes turned out to be quite sophisticated and mathematically intensive and due to the time constraints we could not complete the stroke drawing. The current implementation includes the motor angle calculation to take the arm to a given 2D point and plot the point using a marker.

The major problem was that we did not know how the arm interpolates between two angles i.e. given an arm position A (specified by motor angles) and another arm position B, we did not know what are the precise intermediate arm positions the arm is going to go through. Once we know this, the stroke drawing could be implemented with ease.

Also, currently the only interface to burn the program onto the Dexter ER-2 Robotic Arm is through the GUI provided by Nex Robotics. We were unable to implement our own interface to burn programs onto the Robotic Arm.

7. Future Work

Future work would include

- Drawing the strokes between the plotted points.

- Calculate motor angles using Jacobian method (Inverse Kinematics)

- Develop an interface for the Robotic Arm

8. Conclusions

The current implementation of the project includes plotting of the points given by a vector image. The project implements the angle calculation of motors of the Robotic arm to take it to a specified 2D point.

9. References

http://www.e-yantra.org/ci/projects/code/80 -- Artist bot source code (Implementation on Firebird V)

http://www.youtube.com/watch?v=FQ8-ZnY3qIo – Artist bot video

Manual for Dexter ER-2 Robotic Arm