RECOGNITON-BASED ROBOT WRITING USING CHARACTER SEGMENTATION ALGORITHM

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Abstract— In the realms of rapid evolution of Technology, the entire globe has focused on the common technical Bulls eye- "The Thinking Machine" (The Robot). Technocrats across the world have been executing strenuous efforts to unfold something innovative in Robotic revolution with their peculiar probes.

In this paper, as part of our worthful endeavors contributed to Robotic inventions, we are determined to explore a program which enables a robot to write the Alphabets of English and the Numerals. Through our experiment, it has been proven that the algorithm developed is able to allow the robotic arm to write.

INTRODUCTION:

Since the advent of determined vision of countries for their global dominance on Industrial and Technological platforms, Robot has become one of the most vital and remarkable formulations because of its peculiarities like rapidity and perfection. Researchers have been aiming at constructing a Robot that resembles a human even though it cannot easily perform few simple actions done by a human being, such as Writing. Now, our proposed programme will take us very close to equip a robot with an arm like component that can hold a pen or pencil, which can be utilized for drafting the alphabets and numerals. For analyzing the mechanism and control of said robotic hand, various experiments have been carried out under robotic roof.

In this paper, a character- segmentation-based algorithm is proposed to allow a robot to write characters. This algorithm is based on character recognition using Image processing, which involves processing of digital image, containing pixel values that represents value of each color band in an image (usually 3 color bands; Red, Green and Blue). These values together results in the formation of a 2D integer array which creates the image itself. The characteristics of the abstract image can be denoted by these arrays which act as patterns. Open cv image processing is used to distinguish these patterns.

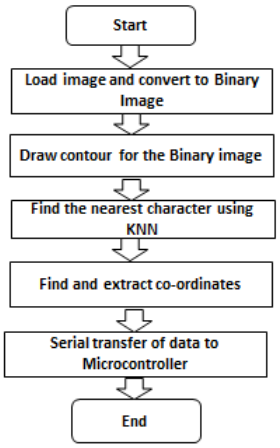
CHARACTER RECOGNITION:

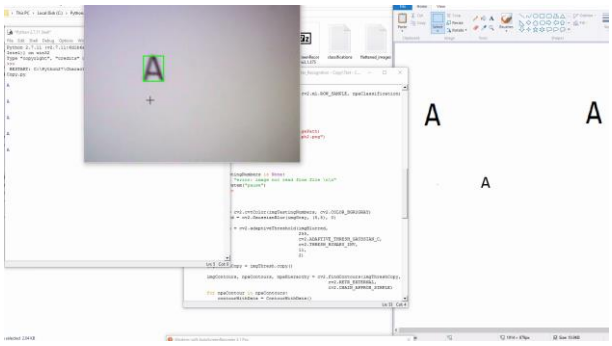
K-Nearest Neighbor algorithm (KNN), the simplest of all Machine learning algorithms, is used to classify the objects in Character recognition, based on the closest training examples in the feature space. Instance-based learning or lazy learning can be seen in KNN, where the function is only approximated locally and all computation is deferred until classification. In this algorithm, classification of an object is by a majority vote of its neighbors, with the object being assigned to the class most common amongst its k nearest neighbors (k is a typically small positive integer).

IMAGE PROCESSING:

Image processing is known as a user friendly process and hence it is used as input for the writing robot system. The image size is preferably A4. Any other paper size, which is in the purview of robotic arm workspace may also be chosen with the spatial coordinate changed into the size of paper in the units of millimeters. The point (0,0) of the word is in the top left of the image, similar to the center point of pixel coordinates.

Initially, conversion of the loaded image into gray scale image[5], rather than binary image, is done because, during gray scaling of the image, hue and saturation information will be deleted in the process of retaining the intensity of the color, and a monochromatic image will be generated. Then, the conversion of the grayscale image into a binary image is done by replacing all pixels in the input image with luminance greater than level (threshold value) with the value 1 (white) and replacing all other pixels with the value 0 (black). The contour is then drawn for the character in the image. Acquiring the nearest character to the contour drawn image from the stored data is done by the KNN (Kernel Nearest Neighbor) algorithm.





CHARACTER SEGMENTATION:

Latin character set of Alphabets play a vital role in Character segmentation. Slash (forward/backward) and curve are the two important components of Alphabets in Latin character set. All the Latin alphabets are made of these two segments. If a Robot can easily draw curve and slash, it is also capable of writing Latin characters with no burden. Before writing a perticular character, proper instruction is needed for a robot, on type and size of the segments for that character. This is how the root of segmentation is fabricated.

In the process of Character segmentation, a character is divided into segments that consist of straight lines and curves for letting the robot to draw the components of the character using its arm. For example,character 'A' is segmented into forward(arguments:end point and height) and backward slash.In case of 'c' the segment is just a curve(diameter and the point).

Forward slash Back slash Curve

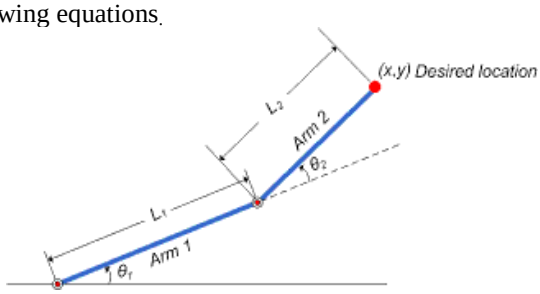
MOVEMENT PROGRAMMING:

To enable a robot to write a character, initially, the movement information of the character is to be extracted from the database derived frm the above methods. When the character is thoroughly figured out, the obtained information should be manipulated using Inverse kinematices to produce the actual data needed by the robotic arm . Assume if the point information in the database represents the displacements from a particular point, then the assesment of the accurate coordinate to be used by the robotic arm is done. Then, a series of robo-specific commands will be originated and consigned to the robot. Based on the catagory of the commands accepted by the robot, these commands will be disimilar for different robots .

ROBOT KINEMATICS:

Using inverse kinematics problems, the values to be taken by the coordinates of the robot's joints for the collocation of the end of the robot's arm (orientation and position) in function of a localization, are attained .

Here is the example to explain how the inverse kinematics of a robot is resolved using geometric method. The starting data are the coordinates pertaining to the system where it wants to position its end.The values of $\theta_1$and θ_2 are calculated using the following equations.



$$X=L_1\cos\theta_1+L_2\cos(\theta_1+\theta_2)$$
$$Y=L_1\sin\theta_1+L_2\sin(\theta_1+\theta_2)$$

MECHANICAL DESIGN:

For mechanical part, A robot manipulator with two degrees of freedom (DOF) is used. The inverse kinematics of a robot manipulator can be calculated very easily and efficiently.The mechanical design of our bot is shown below:

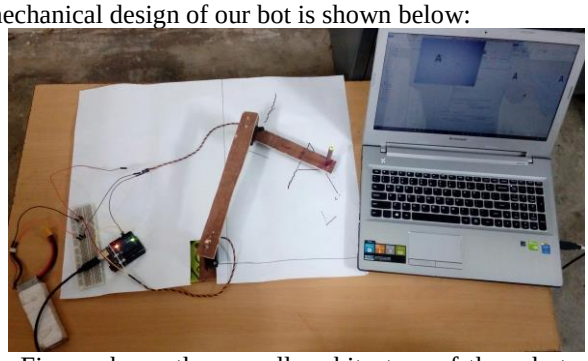
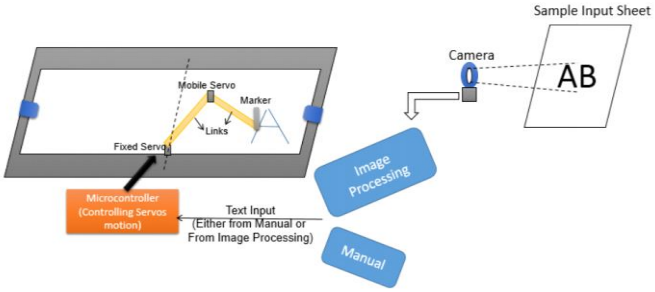


Figure shows the overall architecture of the robot writing system.



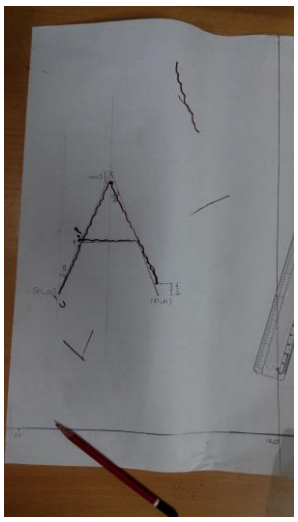
BLOCK DIAGRAM OF THE ROBOT WRITING SYSTEM

CONCLUSION:

The above discussion illustrates a method to enable a robotic hand to write the characters by segmenting them, based on the character recognition. This process involves in conversion of the Image containing the character into binary

system and locating the nearest character to it, using KNN algorithm. Robot Kinematics implements the deduction of the angle(θ). The end point and the height of the character is drawn by the robot using the angle (θ).

As the above algorithm is successful and verified, we are pleased to present it.



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