DETECTION OF INTEGRAL EQUATION BY IMAGE PROCESSING AND GENERATION OF SOLUTION

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Abstract— **Abstract - Integral equations are very important in computations, research and industries for analysis or to find solutions. Also, it is equally important to get the solution of these equations quickly. In this paper, we are proposing a system to detect integral equation by image processing and generate its correct solution. To build such system, The combination of mathematics and Image processing is required. This system is very useful for students.**

Keywords— *Image preprocessing, Sharpening, Grayscale, Optical Character Recognition, Tesseract Engine*

I. INTRODUCTION

The speed of solving mathematical problems such a limits, derivatives, integration, etc., of machines is far greater than the humans. This speed can be increased to a higher level by the advancement in existing technology. This can be done in two ways: (1) Providing faster input to the system, (2) Calculating fast output. The output can be calculated faster by improvement in algorithms but most important thing is how to improve the input speed of the system. This can be done by the involvement of Image processing system.

(i) What is Image Processing?
Image processing is a method to convert an image into digital form to perform operations on it, in order to get an enhanced image or to extract some useful information from image. It is a type of signal distribution in which input is image, like video frame or photograph and output may be characteristics associated with that image or image. Usually **Image Processing** system involves treating images as two dimensional signal while applying signal processing methods to them.

(ii) Challenges for Image Processing
1) *Compression:* A modern trend in image storage and transmission is to use digital techniques. More than 200M images are uploaded daily on facebook only.

Digitizing a television signal results in -100 megabits per second. But bandwidth of channel is expensive.
So for applications such as teleconferencing, one wants to use a channel per second 64 kilobits. For other applications such as mobile videophone and videophone, even lower channel bandwidths (e.g., 9 kilobits per second) are desirable.

2) *Enhancement:* It involves improvement of quality of an image. The quality of the image degrades due to low contrast or noise, or it is blurred, etc. Many techniques are available to improve the quality of image. The challenge is how to remove degradations without changing the signal. For example, noise-reduction algorithms typically involve smoothing which will blur the edges in the image. New methodologies have been designed-e.g., smoothing less near the edges. A challenging problem is then how to enhance quality of extremely poor images.

3) *Recognition:* A recognition system needs to differentiate an unknown input pattern from a set of pre-specified classes. The task is extremely complex due large number of classes and all members in the same class are almost exactly the same. Also the varying size and font makes this task more difficult. Thus, a most challenging problem is how to recognize the patterns of objects.

4) *Visualization:* Commonly, visualization is considered as a part of computer graphics. The main task is to generate image sequences or image based on three dimensional object and scene models. A challenging problem is how to model dynamic scenes containing non-rigid objects (such as clothing, hair, trees, waves, clouds, etc.). The model has to be realistic, and yet the computation cost has to be reasonable.

(iii) APPLICATION OF IMAGE PROCESSING
Document Classification (OCR working as Computer's vision), Shape Recognition, Biometric Authentication, Postal Processing, Script Recognition, Banking, Security,

Modern software applications use Intelligent Character Recognition as a technology of recognizing text in forms filled in by hand (hand-printed),Tests and assessments.

II. EXISTING SYSTEMS

There are various tools or software available on Internet like Symbolab, eMathHelp, Integral calculator, Derivative Calculator etc., these tools allows users to learn, practice and discover math topics using mathematical symbols and text as well as scientific notations. Symbolab provides automated step by step solutions to algebraic, trigonometric or calculus topics covering from middle school through college. Symbolab offers a wealth of smart calculators including: simultaneous equations, equations, inequalities, integrals, derivatives, limits, tangent line, trigonometric equations, functions and more. eMathHelp is a website that provides various functionality to calculate mathematical problems including derivatives, integral equations, online graphing calculator.

The Derivative Calculator supports computing first, second, third …, fifth derivatives as well as differentiating functions with many variables (partial derivatives). Interactive plots/graphs help visualize and better understand the functions.

Advantage: Accurate solution is generated for the given input. More complex equations are also solved by these tools. Some of the tools also show the corresponding graphical representation for the solution.

Disadvantage: The problem with these tools is that some of these services are available online only. The user needs to provide input by entering the operators, parameters one at a time. The tool like matlab requires large memory and processor for functioning.

III. METHODOLOGY

A. *Input in the form of image*

Our system makes takes images of integral equation as input. These images may be of different format such as jpg, jpeg, gif, png, etc. These images can be stored on system or directly captured by camera. Before performing optical character recognition operation on images the preprocessing is done.

B. *Grayscale Conversion*

Current image identification systems uses grayscale images technique for image processing. The grayscale representation of images is quite advantageous over colored images. Grayscale simplifies the algorithm and reduces computational requirements. Color may add unnecessary information and may degrade the performance and the result.

C. *Sharpening*

When we capture the image using camera devices some unwanted data also called as noise get induced in the image. Image S\sharpening is a powerful tool to emphasize texture. Sharpening can often improve apparent image quality even more so than upgrading to a high-end camera lens.

D. *Tesseract Engine*

Tesseract uses Independently Developed Page Layout Analysis Technology. It accepts grayscale image. Modern Tesseract engines can accept colored images also but that affects the result due to unnecessary information. Outlines of component are stored on connected Component Analysis. Nesting of outlines is done which form a Blob by gathering the outlines together. Such Blobs are organized into text lines. Text lines are analyzed for fixed pitch and proportional text. Then by analysis according to the character spacing lines are broken into words. Fixed pitch is divided in character cells and proportional text is broken into words by definite spaces and fuzzy spaces.

Tesseract performs activity to recognize or identify words. This recognition activity is mainly consists of two passes. The first pass recognizes the words. Then satisfactory word which acts as training data is sent to Adaptive Classifier, to recognize the text more accurately. During second iteration, the words which are not recognized well in first iteration are recognized again through run over the page.
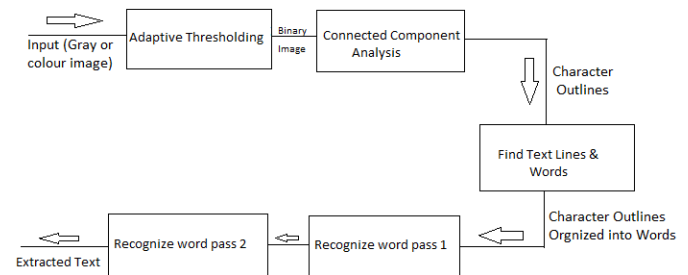

Fig.1 Working of Tesseract Engine

E. *Solve Integral Equation*

Integral Equations are basically categorized into two forms Indefinite integral equations and the Definite Equations these are the equations with some limits. Also there are many types of equations foe example polynomial equations, trigonometric equations, logarithmic etc. The following algorithm is designed to solve polynomial integral equations after extracting the equation from the image.

Step 1: First we recognize the parameters with respect to which the equation is integrated.

Step 2: Read the coefficients of the equation starting from left.

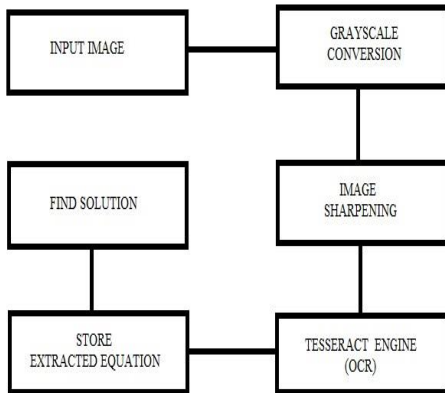Step3: Then operators like '+', '-' etc, are checked

Step4: The powers of all the parameters are checked along with sign.

Step 5: Calculations are done after reading the coefficients and powers of the parameters.
Step 6: Output is displayed.

IV. PROPOSED SYSTEM

Our proposed system combines these functionalities, image processing using OCR algorithm and tools to solve mathematical equations. The whole process takes place in two parts. In the first Part image is provided as input, this image can be already stored or capture the image using camera device. The image can be of different formats like bmp, jpeg, gif, png etc. Pre-processing is done to improve quality of image and the image will be processed by the Tesseract engine to perform optical character recognition to detect the integral equation correctly. In second part the equation is solved by the designed algorithm and output is displayed to user.

V. CONCLUSION

This paper discusses the various image processing technologies, available tools to solve mathematical equations and their advantages and disadvantages. It provides a detailed view of the different potential challenges of proposed system that makes it a difficult task. Image has been a very active research area in recent years. The build proposed system it requires to use OCR technology efficiently. This system is very useful for students.

VI. REFERENCES

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