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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

"Auto Gradation of Handwritten Mathematical Answer Sheets"

Synopsis

for

Minor Project (18IS64)

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In partial fulfillment for the award of the degree of

Bachelor of Engineering

in

INFORMATION SCIENCE AND ENGINEERING

2021

ABSTRACT

This section outlines the details related to the project background, proposed scope, and a perceived technical approach towards attaining the end objective of optical character recognition of mathematical equations using computer vision.

The overall idea behind this project is to develop a computer vision algorithm along with a solution package for recognizing and digitizing steps of solving a mathematical equation written by freehand on a paper, validating the steps and final answer of the recognized handwritten lines by maintaining the context.

The following are the broad modules that will be catered to, towards the realization of the end objective of the project:

1. Workspace Detection using valid markers in the sheet
2. Detecting and localizing each single lines
3. Perform Optical Character Recognition in each detected line

Evaluating each line and providing feedback in terms of red/green bounding box drawn across it where green represents correct and red represents wrong answers.

HARDWARE AND SOFTWARE REQUIREMENTS

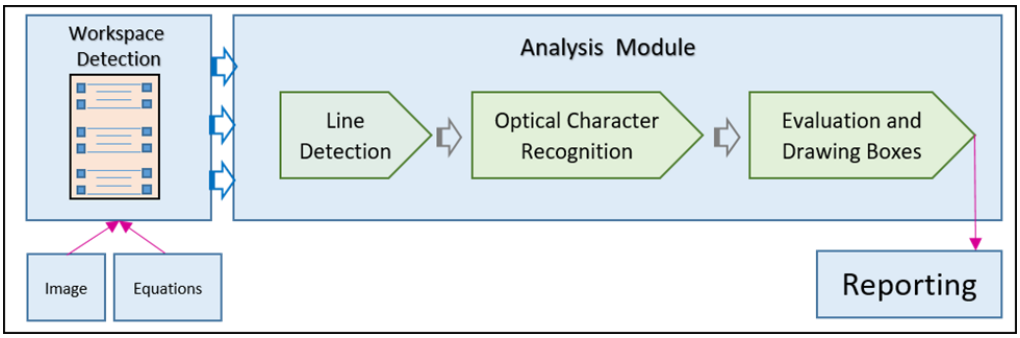
1. Ubuntu 16.04 and above, Windows 10, MacOS
2. CPU Freq. 2.30GHz
3. Google Colaboratory

LITERATURE SURVEY

Although the printed text recognition is considered a clarified issue these days, handwritten text recognition remains a demanding task, mainly due to the huge variation in handwriting among certain people including the size, orientation, thickness, format, and dimension of each written letter or digit. A parallel study of different approaches to each of the modules as described below has been conducted. For the analysis of the workspace, detection of lines can be done either with the approach of forward derivative or using OCRopus. Similarly, the recognition of characters can be done using the Deep Columnar Convolutional Neural Network model trained on the MNIST dataset or using Tesseract, both of whose accuracy needs to be measured for our proposed model. Research papers concerning contour detection, binarization, extraction and recognition of characters, and other mathematical symbols have been studied and the methods mentioned will be considered in the implementation of the project.

METHODOLOGY

The primary functional blocks of the project are outlined in the block diagram below:



The overall solution can be divided into two parts, i.e 'Workspace Detection' module and the 'Analysis Module'. The Workspace detection module is responsible for detecting multiple workspaces in a given sheet of paper using predefined markers. The Analysis module is responsible for detecting and localizing characters in any given single workspace, and mathematically analyzing them, and drawing red, green lines depending upon their correctness.

Two open-source datasets such as MNIST and Kaggle's mathematical symbols shall be used for optical character recognition.

Workspace Detection Module:

1. Finding closed object contours (rectangular boxes)
2. Sorting the contours (top-to-bottom) based on the coordinates
3. Choosing the desired boxes based on the area.

Analysis Module:

1. Binarization
2. Line detection using forward derivative

Character Recognition:

1. Deep Columnar Convolutional Neural Network

(S. G. Raghavendra) **(Dr. B. M. Sagar)**

Signature of Guide **Signature of HOD**