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Feature Extraction Techniques from Digital Image of OMR using Histogram with SIMD

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Abstract— OMR technology is one of the class edge techniques for collecting discretedata in various information systems, OMR system is specific task oriented electro-mechanic hardware for Optical Mark Recognition. First hard copy of OMR sheet is captured/converted into digital image, then the effective use of digital image processing technique based virtual application can extract information marked as bubbled on OMR. The virtualized parallel application can replace the OMR oriented hardware device dependency to acquire OMR technology in discreet information collection system. The parallel application reduces the CPU cost and improves accuracy.

Keywords— OMR, Digital Image Processing, Virtual application, Accuracy, Parallel Computing, SIMD

I. INTRODUCTION

Digital image: Digital image is an electronic data obtained after converting real world coordinate object at specific time via any one of the capturing device or converting hard copy of still image using scanning device [1]. Electronic data of digital image is nothing but a well define matrix; these matrix is collection of smallest division of image data sampled and mapped [2] information using some compression method. Fig.1 showing the digitized image of OMR.

A computerized picture is an electronic record that structures into square picture components (pixels) when shown on a review device (e.g., a PC screen) [3]. The shown picture is a two-dimensional network of thousands or a huge number of pixels each of which has its own location, size, and shading representation.

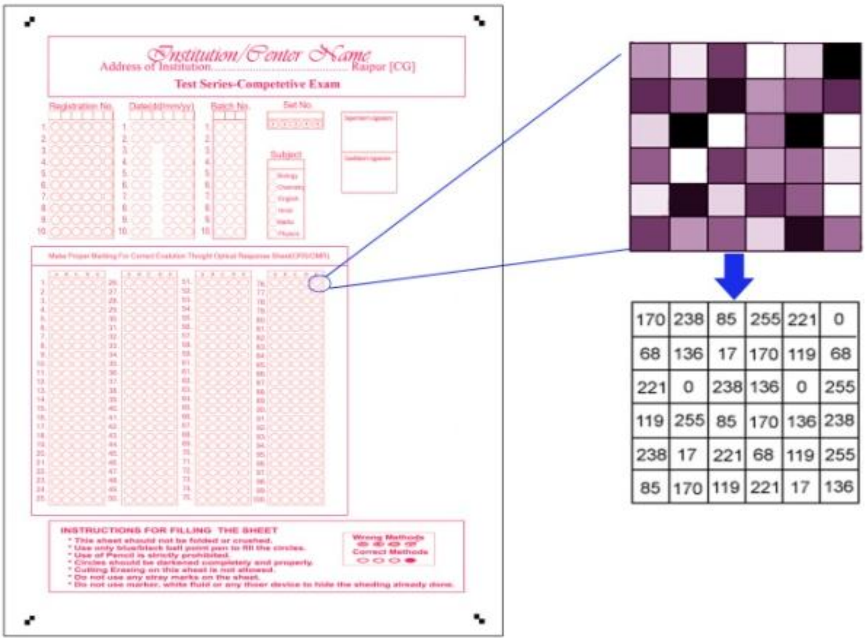

Fig.1: Image of OMR Sheet

Digitizing an OMR means changing over or catching its picture electronically through a scanner or camera. Computerized Digital image programming permits you to amplify a picture to see the pixels, and to now and again measure the numeric shading qualities for every pixel. Individuals use computerized pictures from numerous points of view [2]. The same picture can be seen on a wide variety of screens, transmitted electronically through different frameworks.

Abbreviation terms in Digital Image

"DPI" (dots per inch) is a term that introduces the quantity of dots in a print. This measure is not same as the pixels per inch ("PPI") showed in the Digital image itself [5].

Basic measures: There are two fundamental measures for advanced picture attributes:

- Spatial resolution – capturing Information
- Tonal resolution – color, threshold value etc.

Spatial resolution: Spatial resolution is the sampling rate at which image scanned, or particularly it is the recurrence of pixels used to catch test tones in the space of the article being digitized (e.g., 300 pixels for every inch of the first, or 500 pixels for each inch of the first) [4]. Fig.2 represents the spatial representation. For the most part, more pixels per inch imply a higher determination; yet general picture quality can't be dictated by spatial determination alone.

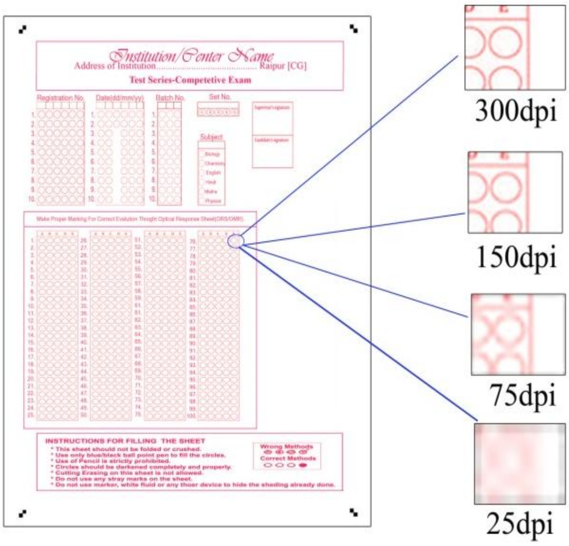

Fig.2: Spatial Resolution

Tonal resolution: Tonal resolution concerned about color and threshold value representation of digital image. Three basic classification of tonal resolution.

- Bi-tonal
- Grayscale
- Colored

Color: Computers represent everything as digital numbers. There are many ways to represent colors with numbers. The widely recognized color system in digital image is to represent to the measure of red, green, and blue essential lights needed to combine to make the wanted hues. This is the convention on the grounds that most PC showcases work by including measures of RGB primaries and the numbers can be utilized to specifically show hues, Fig.3 color image with basic color model. If 8-bit numbers are utilized, then we can have qualities extending from 0 - 255 for each of the RGB primaries of the shading. All things considered, dark would be spoken to by (R=0,G=0,B=0) and white by (255,255,255).

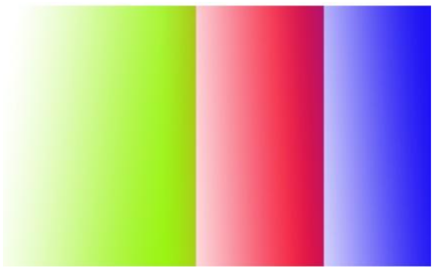

Fig.3: Color Image

Grayscale: Grayscale alludes to the scope of nonpartisan tonal qualities (shades) from dark to white. The shading qualities accessible in grayscale mode have a tonal representation that is undifferentiated from high contrast photography forms and is, consequently, a great decision for speaking to them; gray scale representation is shown in fig.4. It won't catch different qualities found in certain high contrast procedures.

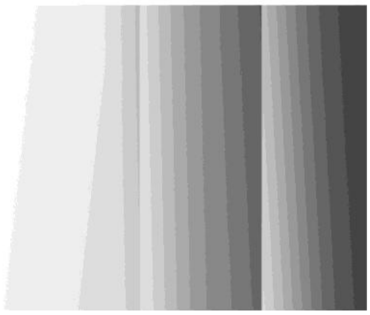

Fig.4: Grayscale Image

Bi-Tonal: Bi-tonal digital image have just dark or white qualities with no shades of dim and requires only 1-bit space for storing data "0" for white pixel and "1" for black pixel. Fig. 5 is bi-tonal conversion of RGB color image. Hence the Bi-tonal mapping of OMR is mathematical representation within a digital image is best suited. Because of 1-bit Bi-tonal digital image can potentially contain only 0(white) and 1(black). Picture details for the most part contain least and greatest worth reaches for the white and dark focuses in a computerized picture.

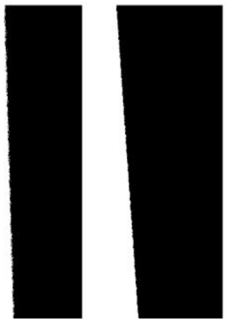

Fig.5: Bi-Tonal Image (Binary)

SIMD: Each unit will be executing the same guideline, every execution unit has its own location registers, thus every unit can have diverse information addresses numerous information streams in parallel with a solitary direction stream SIMD preparing structural planning example— a realistic processor handling directions for interpretation on different operations are done on numerous information.

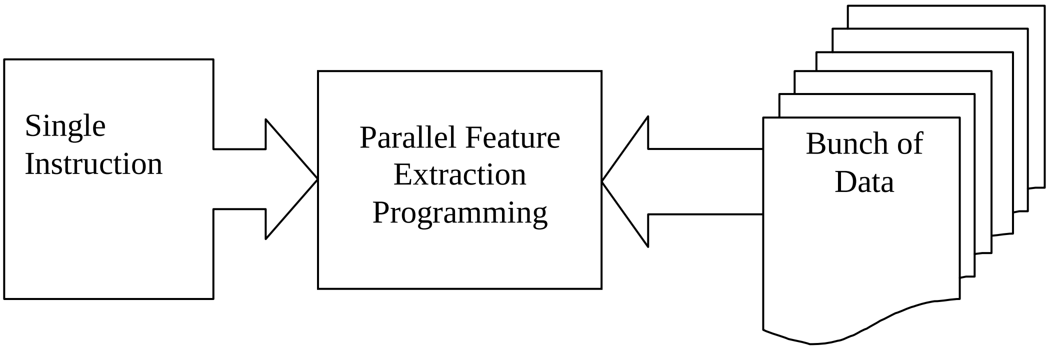

Fig.6: Parallel extraction architecture (SIMD)

II. METHODOLOGY

The building design of proposed framework is displayed in Fig 7. The procedure of characterization begins with procurement of OMR digital image to the frameworks.

Various products developed were at the last stage and prepared to evaluate when pictures were caught. Here it is worth mentioning that we have used the captured digital image is pre-processed by using different image enhancement techniques. During this process, the image is oriented to our application and segmented into regions containing individual responses. The segmentation decreases the intricacy of information as well as gives blobs containing one and only protest of imprint for neighbourhood components set. Besides, arrangement of the pictures is changed from ".jpg" to ".bmp". Thereafter, pictures were changed over from RGB to Bi-tonal as demonstrated in fig. In the wake of changing over pictures into bi-tonal, distinctive investigations were completed to resize the pictures like pictures of size 128 × 128, 256 × 256 and 512 × 512 and so on. The motivation behind the resizing was to make a standard measured information set for all investigation.

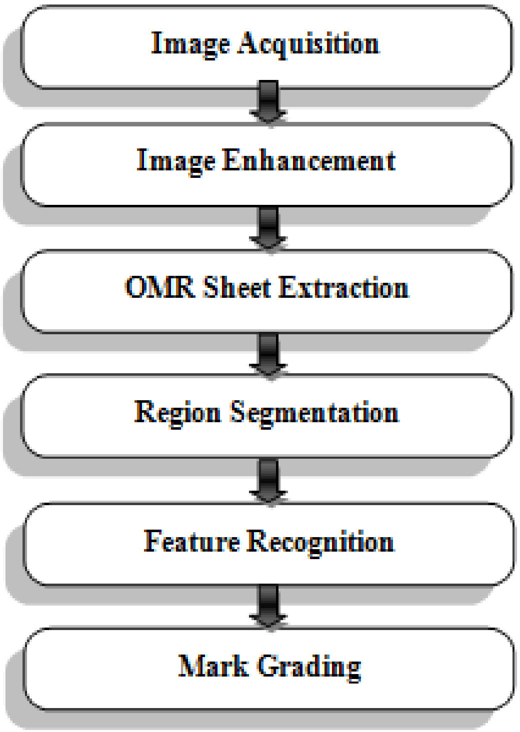

Fig. 7: Work Flow

III. IMPLEMENTATION

For implementation of our system, VB.net framework is used image pre-processing for implementing different Feature Extraction Techniques. Large data sets have been used to carry out number of classification experiments using various sets of features.

Image Acquisition: The principal phase of any vision framework is the image acquisition. After the picture has been gotten, different routines for handling can be connected to the picture to perform the various vision assignments obliged today. The minimum required quality to achieve the goal is shown in fig.8. Be that as it may, if the picture has not been gained attractively then the proposed assignments may not be achievable, even with the guide of some type of picture upgrade.

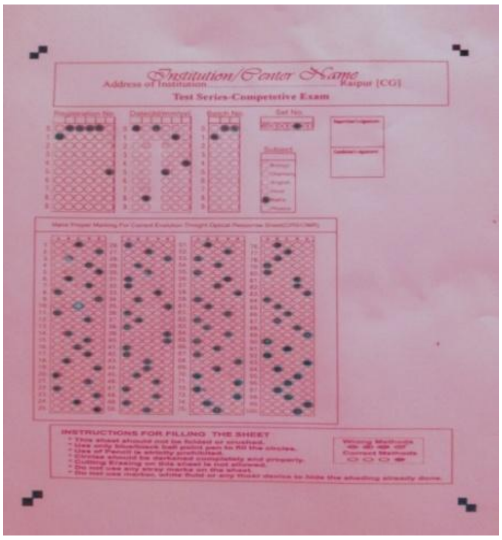

Fig.8: Image Acquisition

Image Enhancement: Enhancement is increasing the quality of digital image (needed e.g. for visual investigation OMR examination), without learning about the wellspring of debasement. In the event that the wellspring of debasement is known, one calls the procedure picture rebuilding. A wide range of, frequently basic and heuristic systems are utilized to enhance digital image in some sense. The issue is, obviously, not very much characterized, as there is no target measure for picture quality. Here, we talk about a couple of formulas that have demonstrated to be helpful both for the human spectator and/or for machine acknowledgment. These routines are exceptionally issue arranged: a strategy that works fine for one situation may be totally lacking for another issue, image correction improve the quality of image which is shown in fig. 9. The main concerned is skew angle correction and image resolution in image enhancement There are a few normally utilized systems for distinguishing skew as a part of a page, some depend on recognizing associated segments (for some reasons, they are generally identical to characters) and discovering the normal points associating their centroids.

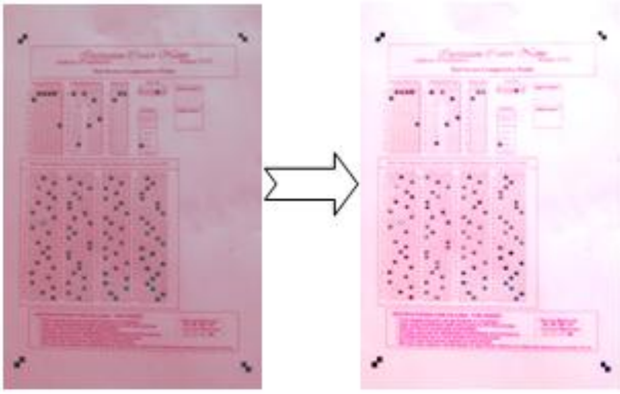

Fig.9: Image enhancement Result

OMR sheet Extraction: extraction is empowered by setting the name of the yield document utilizing the parameter image set. The name of the sections to use for the 'X' and 'Y' axis of the picture are situated utilizing the parameters x-s segment and y-segment. The scope of the segment utilized for OMR extraction is resolved using the same calculation concerning the vitality section in unearthly extraction, and is controlled and decided autonomously for the 'x' and 'y' segments. After Appling OMR extraction process the result is shown in fig. 10.

Fig.10: OMR Extraction

Region Segmentation: segments a picture into particular areas containing every pixels with comparative characteristics. To be important and valuable for picture investigation and translation, the districts ought to emphatically identify with portrayed protests or elements of premium [12]. Important division is the first stride from low-level picture preparing changing a grayscale or shading picture into one or more different pictures to abnormal state picture Portrayal regarding components, items, and scenes. The accomplishment of picture examination relies on upon unwavering quality of division, however a precise apportioning of a picture is for the most part an extremely difficult issue, and Fig.11 gives segmentation result.

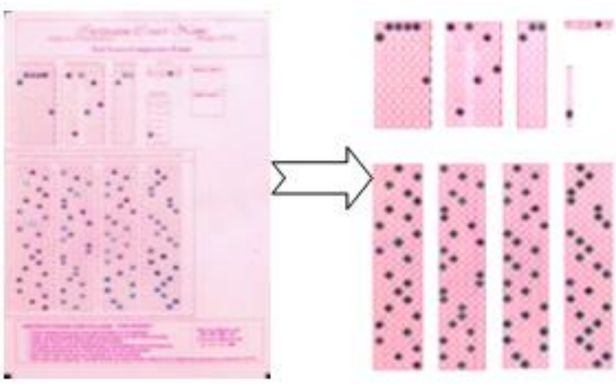

Fig.11: Segmentation of OMR sheet

OMR Recognition: Similarly as with whatever else, pictures come in various types and fill distinctive needs. At times, a little size is essential and at different times, holding a high shading profundity is the thing that you need. With a specific end goal to change picture to one of these modes RGB, Grayscale and Binary (Bi-tonal) [10]. OMR recognition system best suited for Bi-tonal image mode which helps effective mark recognition. Respective bi-tonal image of OMR is shown in fig.12.

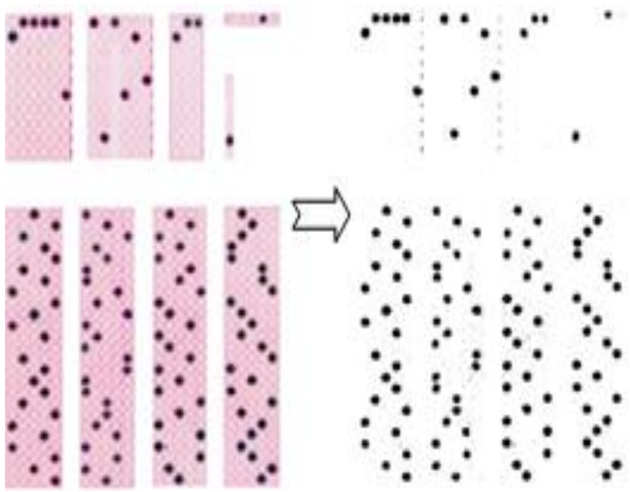

Fig. 12: Mark Recognition

Virtual rectangular areas which give or take bound the circular area [7].These are indicated as red shaded boxes areas composed nearby them. We know the relative position of each bubble in the registered image. All the bubbles are bound in the 5 sub answer boxes. And the sub-answer boxes are themselves bound in main answer box. Relative to each sub answer boxes, we use a standard value of position of the bubbles.

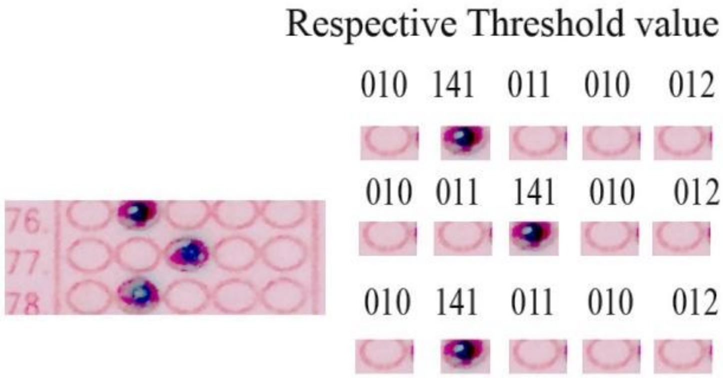

Fig. 13: Mark grading

IV. RESULT

Table (1) presents the analysis results of the feature extraction time (CPU time) for calculating each OMR sheet digital image after performing the investigated algorithms.

TABLE 1

CUMULATIVE RESULT

Size of questionnaire	**Size of Choice**	**Average Calculation Time(ms)**
50	4	.0329
50	5	.0331
100	4	.0330
100	5	.0332

150	4	.0332
150	5	.0333
200	4	.0332
200	5	.0332

Fig. 14 shows the CPU costs of extraction algorithm with distinct number of choice, where the size of questionnaire has been normalized to that of size of choice (indicated by the horizontal line in the figure).

Fig. 14: CPU Cost for the Recognition process

Table (2) presents the analysis results of the feature extraction time (CPU time) for calculating each OMR sheet at different CPU architecture. Table2 shows the CPU costs in terms of milliseconds for extraction algorithm with different CPU architecture, where the size of questionnaire is limited to 100 with 05 choices for each and have been normalized to that of variety of CPU architecture (indicated by the polygon in the figure).

TABLE 2

ANALYSIS REPORT ON DIFFERENT CPU ARCHITECTURE

CPU	**Speed**	**Average Calculation Time(ms)**
Celeron	1.83 GHz	0.2901
Pentium	1.85 GHz	0.1856
Celeron Dual-Core	2.0 GHz	0.1805
Pentium Dual-Core	2.30GHz	0.1528
Core 2 Duo	2.50GHz	0.0624
Core 2 Quad	2.80 GHz	0.0513
Core i3	3.00 GHz	0.0383
Core i5	2.94 GHz	0.0312
Core i7	2.95 GHz	0.0202

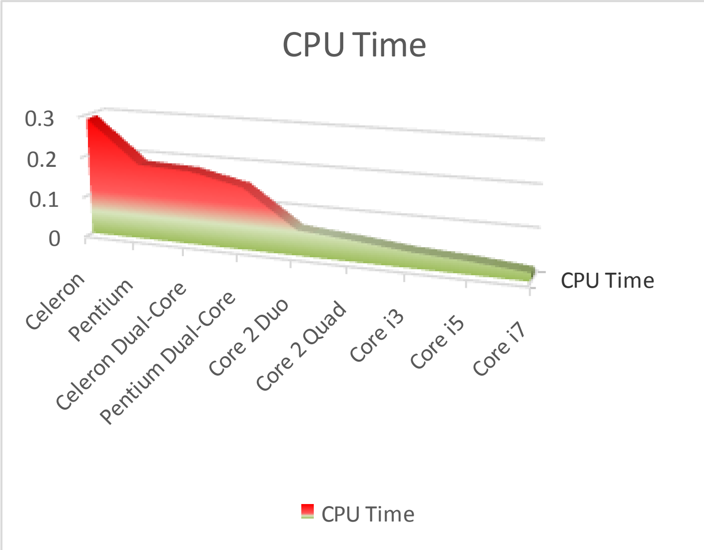

Fig. 15: data visualization of Analysis report on different CPU architecture

V. CONCLUSION AND FUTURE WORK

A proficient substance based Image recognition framework obliges fantastic substance based system to adequately utilize the majority of the data from the digital Image. In this paper, a study had been done on threshold element extraction parallel computation systems from the surface, shape of image to secure point of interest examinations on recovery precision for every strategy components on OMR digital Image. In future, we plan to evaluate this approach by implementing on a variety of parallel architectures with support of GPU.

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