

A NOVEL OPTICAL MARK RECOGNITION TECHNIQUE BASED ON BIOGEOGRAPHY BASED OPTIMIZATION

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ABSTRACT: Optical Mark Recognition (OMR) is the automated process of capturing the data which is in the form of bubbles, squares or tick marks. This technique is widely used in various applications like exam evaluation, automated attendance marking, voting and community surveys etc. Though the technique usually makes use of commercially available dedicated OMR scanners, but it has its own drawbacks.

Keywords: Optical Mark recognition, literature review, Mechanism.

1. INTROUCTION TO OPTICAL MARK RECOGNITION

Optical Mark Recognition (also called Optical Mark Reading and OMR) is the process of capturing human-marked data from document forms such as surveys and tests. Many traditional OMR (Optical Mark Recognition) devices work with a dedicated scanner device that shines a beam of light onto the form paper. The contrasting reflectivity at predetermined positions on a page is then utilized to detect the marked areas because they reflect less light than the blank areas of the paper. Some OMR devices use forms which are preprinted onto 'transoptic' paper and measure the amount of light which passes through the paper, thus a mark on either side of the paper will reduce the amount of light passing through the paper. OMR is generally distinguished from optical character recognition (OCR) by the fact that a complicated pattern recognition engine is not required. That is, the marks are constructed in such a way that there is little chance of not reading the marks correctly. This does require the image to have high contrast and an easily-recognizable or irrelevant shape. The most common use of optical mark recognition is to process student responses to a multiple choice exam, or responses to a questionnaire or feedback form. Typically the questions are provided on paper, and Students mark their responses onto special pre-printed forms. These forms are then read automatically. Some departments (e.g BTO, Economics, Medical School) already make extensive use of OMR systems; others who do not have sufficient demand to justify dedicated equipment of their own use the service provided by Information Services to process smaller numbers of

examinations or feedback forms. Exams processed in this way can usually be returned to departments within a couple of days. Detailed analytical results are provided.

Related Work: Dillman, 2000 in "Optical Mark Recognition" presents the impact of OMR forms on response rates that it is a relevant issue. One possible disadvantage with OMR surveys is that they may suppress response rates. This can occur for several reasons. OMR surveys are often combined with other cost-cutting measures (e.g., no follow up), so their low response rates may simply be an artifact of other choices about survey administration [2].

Symons, 2001 states MCQ is generally recognized as one question with some alternative answers where one is correct and the others are "distracters". This is multiple choice but there are permutations such as Multiple selection (any number of right answers), Numeric, multiple true-false (where the answer is true, false or the respondent can abstain), or Comment questions (space for qualitative answers) [4].

Lais, 2002 defined that Optical character recognition (OCR) is the translation of optically scanned bitmaps of printed or written text characters into character codes, such as ASCII. This is an efficient way to turn hard-copy materials into data files that can be edited and otherwise manipulated on a computer. This is the technology long used by libraries and government agencies to make lengthy documents quickly available electronically.

Ruberto, 2004 presents a novel method to automatic 2-D shape recognition. The novel approach is based on finding a skeletal representation of a shape, which resumes its geometrical and topological features, useful for indexing in a database of shapes. A framework is designed to improve the effectiveness potential of medial axis in recognition by creating a richer and cleaner version of the shape skeleton, defining an attributed skeletal graph to model the shape. The shapes are then matched by comparing their attributed skeletal graphs.

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Hussmann S. et al, 2005 presented his paper “**A high speed optical mark reader hardware implementation at low cost using programmable logic**”. It has described the development of a low-cost and high speed OMR system prototype for marking multiple choice questions. The novelty of this approach is the implementation of the complete system into a single low-cost Field Programmable Gate Array (FPGA) to achieve the high processing speed. Effective mark detection and verification algorithms have been developed and implemented to achieve real-time performance at low computational cost. The OMR is capable of processing a high-resolution CCD linear sensor with 3456 pixels at 5000 frame/s at the effective maximum clock rate of the sensor of 20 MHz (4x5 MHz). The performance of the prototype system is tested for different marker colors and marking methods [7].

Sabyasachi Das, 2010 in “Optical Mark Recognition Technology for Rural Health Data Collection” presents OMR technology has been used for various large scale surveys from different Governmental agencies (IT and population census; Paper to be presented in Forum for Asia Pacific Statistics, 3-4 Feb 2005) (Expert Group Meeting on Effective Use of IT in Population Census, 2007) to Microfinance companies like Equitas (EQUITAS Launches Optical Mark Reader based (OMR) solution, 2010) to collect customer enrolment data. Equitas has experienced thrice the normal efficiency by shifting from a conventional process like manual key-stroke entry to an OMR scanning (Innovation in Technology Report, Equitas) [1].

Pegasus Imaging Corporation [6] presented a **Software Development Kit (SDK) for OMR recognition from document images**. The SDK supported template recognition mode and free recognition mode. An OMR field is defined as a rectangle area containing a specified number of columns and rows of bubbles to be evaluated. The SDK can scan the region horizontally and then vertically to locate the bubbles apart from the spaces between them. Then, based on the bubble shape specified, it scans the discrete areas of the bubbles, counting dark pixels to determine which bubble areas qualify as “filled in”. The Pegasus’ technique can support the plain paper’s printing and design, but in the application in the school, the multi-choice answer recognition success rate cannot achieve the requirements of the examination.

Present Work: The proposed algorithm follows the Biogeography Based Optimization Biogeography is nature’s way of distributing species, and is analogous to general problem solutions. Suppose that we are presented with a problem and some candidate solutions. A good solution is analogous to an island with a high HSI, and poor solution represents an island with a low HSI. High HSI solutions resist change more than low HSI solutions. By the same token, high HSI solutions tend to share their features with low HSI solutions. In the present problem, the different

colors are considered as different solution habitats. We have considered the popular colors as candidate solution with high HSI & other colors as candidate solution with low HSI. We have followed the main Migration technique of BBO theory for the purpose of color reduction.

The algorithm is as follows:

Step 1: Initialize the BBO parameters. Initialize every black and white color as a different habitat containing a number of pixels (species).

Step 2: Initialize a random set of habitats, each habitat corresponding to a potential solution to the given problem.

Step 3: Select the color represented by maximum number of black and white as the max and color represented by minimum number of colors as min for defining a range to categorize the habitats.

(i) Habitats with number of pixels lying in the range min to $1/2 * \text{max}$ are habitats with low HIS.

(ii) Habitats with number of pixels lying in the range $1/2 * \text{max}$ to max are habitats with high HIS.

Step 4: The immigration rate and the emigration rate is decided based on the HSI value. High HSI habitats have low emigration but high immigration, whereas a low HSI habitat has high emigration but low immigration rate. For the migration of pixels the habitat RGB color value is first converted to LAB color value & then a pixel is migrated if

(i) Its habitat allows émigration.

(ii) the second habitat allows immigration.

(iii) CMC color distance between two habitats is less than 0.4.

Step 5: Probabilistically use immigration and emigration rates to modify each non-elite habitat as discussed i.e. perform migration from low HSI to high HSI.

Step 6: For each habitat, update the immigration & emigration probability of its species count using (2). Increase the CMC color distance threshold by 0.1 for every iteration. Iterate till the required number of habitats left.

Result and Discussion

Example 1: Sample for Training



Circle Center detected at (12, 12)

Filled Circle1



Circle percentage filled: 84%

Filled Circle2



Circle percentage filled: 41%

Example 2: Sample for Training



Circle Center detected at

12	12
12	41
12	75
12	105

Filled Circle and percentage



3% 65% 0% 100%

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