



# An Efficient, Cost Effective and User Friendly Approach for MCQs Treatment

Ismail Khan, Sami ur Rahman, and Fakhre Alam\*

Department of Computer Science & IT University of Malakand Chakdara, KP, Pakistan

**Abstract:** The ongoing era is called the technology era and every one want to have automatic system means that the work is done just on one click. The inclusion of human being in any work may become problematic, fraudulent and unsophisticated. We keep the need of current time and decide to develop such a system which is capable of to automatically grade Multiple Choice Questions (MCQs) paper. Manually grading/marketing of a paper is time consuming, boring and complicated task. Moreover, it may possible to make fraud by fraudulent examiner during paper marking. In this paper, we have proposed a novel approach for automatic paper grading. The proposed approach is user friendly and efficient, which will mark a candidate's answers automatically and return, within a very short period. The proposed system for MCQs marking consists of a camera and computer, and can accept any type of marking on bubbles.

**Keywords:** Paper Marking, Mark Reader, Image Processing, Image Segmentation

## 1. INTRODUCTION

As compared to automatic system the manual marking/grading of a paper is complicated and time-consuming task. The examiners are also uninterested by using this manual method. Fraudulence, wrong calculation and mistakes may also be possible in this method. Due to such types of mistakes may lead deserved students to bottom. In order to avoid such types of errors and to save examiner's time it may be better to have an automatic system. We want to solve this crucial problem, to save examiner's as well as student's time. Due to writing details in subjective test a student, waste a lot of time. While the objective (MCQs) test requires limited time for paper attempting.

We developed a system, which automatically grade MCQs type test automatically. The proposed system is user friendly, save candidate's time and inexpensive. The proposed system provides full permission to candidates on circle marking. The candidates are allowed to mark MCQs options by his/her own styles. So it saves a lot of candidate's time by providing such type of freedom. The proposed algorithm requires camera (mobile/digital/scanner) and computer. These resources

are affordable for interested user or organization. The algorithm has some novel characteristics like saves the candidate's time, required low cost and user friendly. We also use some of the best image enhancement filters and techniques like histogram equalization that increase the accuracy rate.

Most of the existing systems in markets are working through dedicated scanners which are also known on Optical Mark Reader (OMR) [1,2]. Besides paper grading this technology is also use for survey, questionnaire etc. This system requires some conditions that should be followed by candidates like circle marking so it is not user friendly. The system also requires high cost which is not affordable for everyone. Nutchanat and Akawee [3-7,9-15] have suggested a system which is based on cross mark in grid form sheet instead of filling circle or square. A camera based work is presented by Al-Marake and Kosolapow [4,15]. Another system presented by Jantschi [4] is an online system instead of manual marking using a database of MCQs for testing of different subject. There exist other systems [3,5,7,12,13] which use scanner for image acquisition and pre-defined answer sheet (a marked master copy).

In the above systems, the concept of ‘master copy’ requires image registration. Image registration is a process to bring similar objects into same co-ordinate position of input sheet and master copy for answers comparison. On circle marking the requirement of the existing systems is to shading or by specific way (Fig. 1). There are also few systems which uses cross symbols for selecting the correct option. We will use camera instead of scanner which will increase the speed and decrease the cost of the system because a camera can read multiple papers at a single time and have low cost as compared to OMR scanner. The price of normal camera is about Rs 7000 to Rs 15000 [1]. We also studied about different work related with image enhancement like noise removal, enhancing and smoothing filters in [8,10,11,14].

The filling of circles or marking answers in a specific way wastes time and any mistake in marking the answer in that specific way may lead to wrong marking and loosing of marks. The available systems are very expensive and the normal price is about Rs 40,000 to Rs 250,000 [1,2]. The available OMR technology is working on dedicated scanner. Normally the speed of scanner is low as compare to camera. These OMR scanners require the control environment like, specific thickness of paper, have specific colour of paper and completely filling the bubbles. These systems are also required technical and experienced people to operate it.

## 2. PROPOSED SYSTEM

In our new work we propose a system which understands any tick mark symbol (Fig. 2). This system will give more freedom to the user and will be able to save the user time. Our proposed system is user friendly, efficient and cost effective as compared to the available systems.

We design a special type of answer sheet of 100 questions in Corel-Draw. The using of Coral draw is not necessary the algorithm can also work on any other designing tool. Then import that sheet to MS word and mail merged with MS Access database for inserting user information (Fig. 3).

Basically the sheet consists of three sections. The first section for user information that is mail-merged from database. The second section is used for marking roll number which assigned by the test



Fig. 1. Symbols supported by existing systems

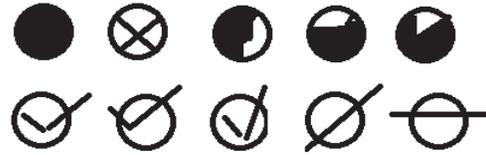


Fig. 2. Symbols supported by propose system

1		Mark Your Roll Number					
Name	Ismail Khan		0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Father Name	Ghafoor Ur Rahman		1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CNIC	15701-7389456-9		2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Roll Number	38502		3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Note: Mark Only One Option against each question.							
3		A	B	C	D	E	
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	26
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	27
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	28
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	29
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	30
		A	B	C	D	E	
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	51
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	52
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	53
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	54
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	55
		A	B	C	D	E	
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	76
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	77
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	78
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	79
		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	80

Fig. 3. User information through mail merging

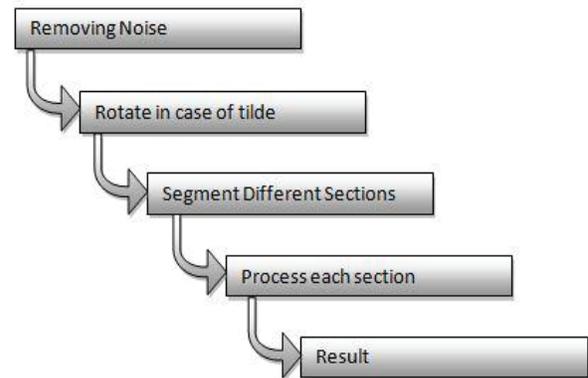


Fig. 4. Basic image processing steps

conductor. The third section is the important portion in which user will mark the MCQs options. This algorithm use basic image processing techniques for solving the problem. A user takes image of MCQ based answer sheet and give as input to the algorithm. The algorithm process the sheet for further information as shown in Fig. 4.

In the above steps when the algorithm reached to segmentation the paper is segmented into three sections. These sections consist of User information,

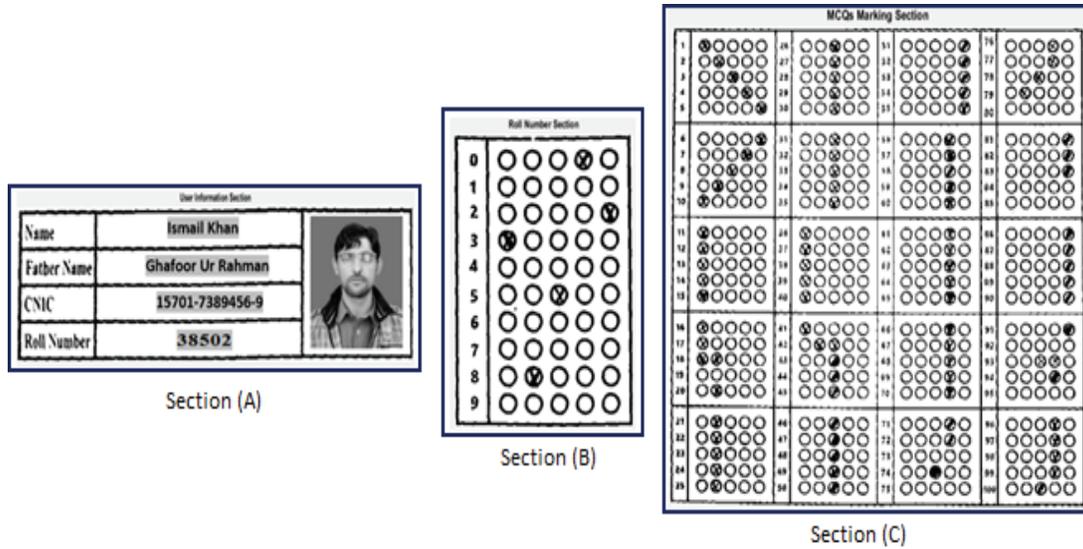


Fig. 5. Extracting three sections from paper

Roll number and MCQs sections (Fig. 5).

We have prepared a database in MS Access to store the user information and questions of subject with options. From the database the test conductor will prepares questions paper. The questions paper and MCQs answer sheet will be given to students to mark the answer. When the students complete this task the operator will capturing the answer sheets through camera and give the images as input to Automatic Paper Marking System (APMS). The AMPS process the sheet in a few steps. First it crops the extra area which not require. Now the required area processed for further information. The cropped area is subdividing into three sections like in Fig. 5. Then each section is processed separately. We apply different filters on each section like noise removal, enhancement and smoothing the image [8, 10-11, 14].

The system will check the paper and store the result back into database for future information. The following are the basic steps of the processing and recognition of bubbles area:

- a) Image acquisition  
In our proposed system we used camera for image acquisition.
- b) Image preprocessing  
The standard image preprocessing techniques are applied like converting to binary, edge detection, rotating, object separation, object detection and recognition.

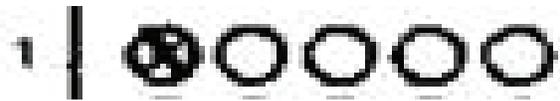


Fig. 6. Separating Question

- c) Segmentation  
Separate each question along with its options (Fig. 6).
- d) Recognition of marked option(s)  
This is the step where we recognize the options differently. Our method uses sum of the numbers of pixels and decide whether pixels have been added to the option or not. This is an efficient method to know whether an option has been marked.
- e) Check whether the marked option is correct or not. Matching with database entries.
- f) Result

We set the ratio of black and white pixels (2:3) 45% and 55% of bubble recognition. When the black pixels ratio exceeds from 40% then it should be conceived that it is marked otherwise unmarked. We used the region props algorithm which measure properties of image regions like extracting Bounding box, Centroid, Euler number, Perimeter, filled area and so on. This algorithm are designed using Matlab, MS Access and follow the basic image processing steps like image acquisition, preprocessing, segmentation, features extraction and result. The MS Access database is used for

storing the questions with multiple choice answers. The system interacts with database for different types of queries.

### 3. RESULTS

For evaluating the performance of the algorithm, we performed a series of experiments. We investigated the user friendliness of the proposed algorithm, its performance on low quality images and its implementation cost.

In traditional systems, the users have to fill the circles for marking the answers, which takes a lot of time. In our experiment we have provided freedom to the users and they can use different options for marking the answers. The option includes filling

the circles, tick marking the circles or crossing the circles. For comparing the time needed to mark the answers, we selected 40 students. Half of the students were asked to mark the paper using the traditional style i.e. filling the circles while the other rest of the students were left free to mark the answers. They were allowed to mark the answer by either filling the circles, tick marking the circles or crossing the circles. In this experiment we only considered the time needed for marking the answers and ignored the thinking time for finding the answers.

The result of this experiment is shown in Fig. 7. The results show the proposed algorithm saves 80% time in answers marking. We also tested the algorithm in terms of input image quality. We have

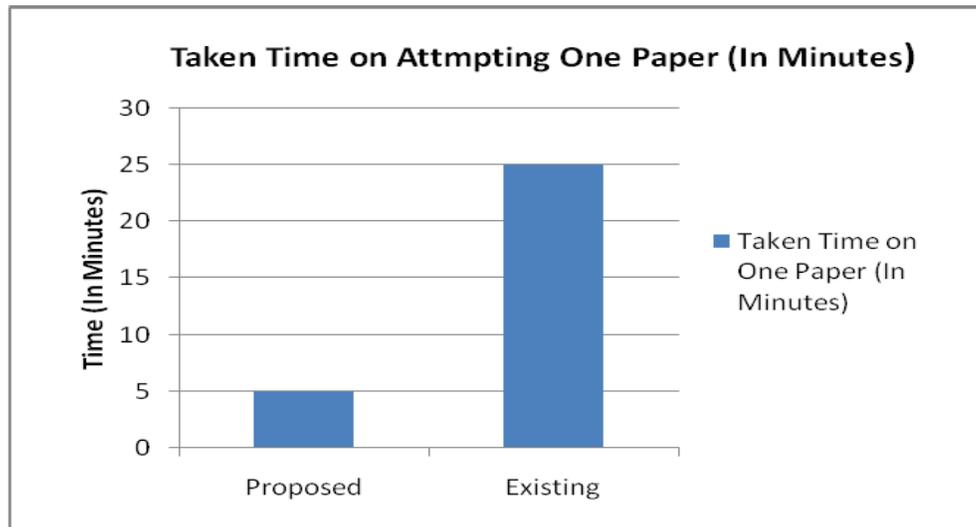


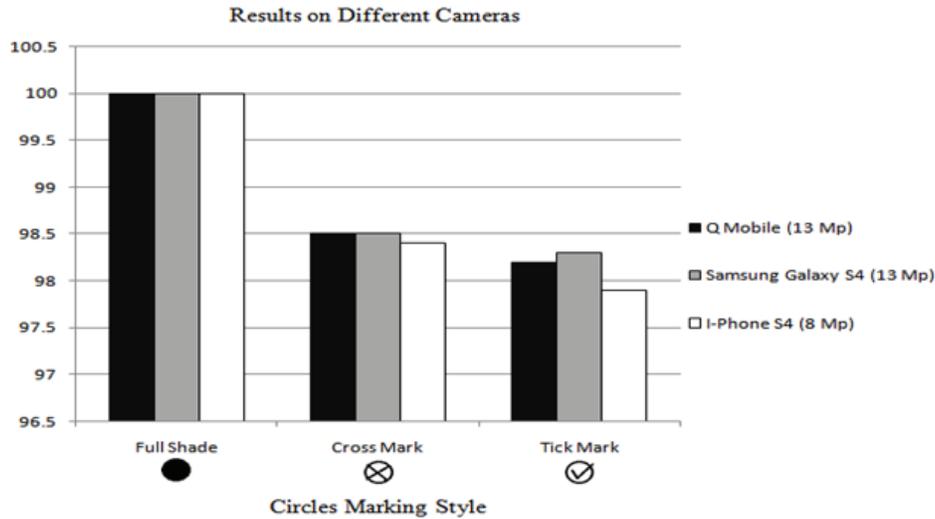
Fig. 7. Time comparison between proposed and existing system

Table 1. Total number of tested papers with results

S.No	Number of Paper	Number of Questions	Result	Image-Quality	Mark-Type of circle
1	30	100	94.5%	Bad	Cross
2	30	100	96.3%	Bad	Filled
3	30	100	97.7%	Moderate	Cross
4	30	100	98.8%	Moderate	Filled
5	30	100	99.6%	Good	Cross
6	30	100	100%	Good	Filled
<b>Total: 180</b>			<b>Average: 586.90/6=98%</b>		

**Table 2.** Cost comparison between proposed and existing system

System Type	Requirements	Price (without computer of laptop)
Proposed	Computer or laptop, Camera	R.s (7000-15,000) [15]
Existing	Computer or laptop , OMR Scanner	R.s (40,000 – 2,50,000) [1-2]

**Fig. 8.** Results of using different cameras

used cameras of different resolution including Mobile phone camera and digital cameras. In this experiment we scanned 30 papers. Fifteen papers were scanned using digital cameras and fifteen papers were scanned using mobile phone camera. In both cases equal papers were marked by filling the circles, tick marking and crossing the circles. The results of this experiment are shown in Table 1 while its graphical representation is shown in Fig. 8. The proposed algorithm also needs limited resources as compared to the existing approaches. A comparative study of the resources needed is shown in Table 2.

#### 4. DISCUSSION

The proposed algorithm is cost effective and user friendly. For implementation, it needs only a computer and a camera so it is affordable for every organization. The system is easy to operate and even inexperienced people can also operate it. The system gives freedom to the users for answer marking and it saves candidate's time. The results show that the performance is not good when image quality is bad and the circles are not filled. However the performance is good when circles are filled even

if the image quality is not good as shown in Fig.7. The minimum requirement of the proposed system is 5 megapixels camera.

#### 5. CONCLUSION

In this paper, an algorithm is proposed for automatically grading Multiple Choice Questions (MCQs) paper. Manually grading/marketing of a paper is a time consuming, boring and complicated. The proposed algorithm save a lot of user time, require low cost and is user friendly. The algorithm accepts any type of mark on bubbles that give more freedom and save a lot of user's time. The results show the proposed algorithm saves 80% time in answers marking. The proposed algorithm required only a camera and computer. The performance of the algorithm is satisfactory (95%) even if the input image quality is not good. The performance can be improved for bad images by investigating image enhancement techniques for improving the quality of the images.

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