EFFICIENT SYSTEM FOR EVALUATION OF OMR SHEET

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ABSTRACT

Optical mark recognition is the process of capturing human-marked data from document forms such as surveys and tests. This technology provides a solution for reading and processing large number of forms such as questionnaires or multiple-choice tests. It is widely used, especially for grading students in schools. Today we find that lot of competitive exams are being conducted as entrance exams. These exams consist of MCQs. The students have to fill the right box or circle for the appropriate answer to the respective questions. So our aim is to develop Image processing based Optical Mark Recognition sheet scanning system. In this system OMR answer sheet will be scanned and the scanned image of the answer sheet will be given as input to the software system. Using Image processing, we will find the answers marked for each of the questions, total marks and displaying of total marks will be also implemented. The existing systems available for the same purpose are costly, working on particular scanners only and dependent on other parameters such as paper and print quality. The proposed system consists of an ordinary printer, scanner and a computer to perform computation.

Keywords: *OMR, Multiple choice exams, Image processing, Adaptive Threshold, Scanner*

1. INTRODUCTION

OMR technology has changed much in recent years. Now a day in schools, colleges and classes OMR technology is used. Exams are conducted using OMR answer sheet checking system because by using this technology the conduction of exam is getting much easier, powerful, and cheap[4,6].

Optical Mark Recognition (OMR) is the process of gathering information from human beings by recognizing marks on a document. OMR is accomplished by using a specialized and dedicated Infra-Red OMR scanners. OMR device simply detects whether predefined areas are blank or have been marked. OMR scans a printed form and reads predefined positions and records where marks are made on the form. OMR allows for the processing of hundreds or thousands of physical documents per hour. The existing system requires special hardware which turns out to be very costly for any organization. So using such a system may be cost inefficient or not feasible by organizations it is the need of the hour to develop system which would be cost effective and time effective in other words cheap and best. The error rate for OMR technology is less than 1%.

Nowadays, MCQs has become a fast and reliable method for national entrance examination over the world, because it can assess students with the broad range of knowledge coverage within a limited time period. However when the use of MCQ is more demanded, a manual grading solution seems harder Several applications based on Optical Mark Recognition technology (OMR) [1][5], have been developed to resolve this problem. An OMR machine and the corresponding OMR software are the highlights of them. The scanning machine, referred to as OMR scanner, can hold a large numbers of forms and read them as they are automatically fed through the machine.

OMR machines with specialized and dedicated Infra-Red OMR scanners have been recently popular mainly because of their high execution speed and appreciable accuracy. Infra-Red OMR scanners work only for specific color and

thickness of the form hence cannot be printed on a general purpose printer. Another problem with OMR machine are its price and operating cost due to MCQ scoring papers which are more expensive than plain papers[9]. The reduction in cost of information technological devices have brought about the replacement of the pricey OMR with simple scanners.

2. PROPOSED SYSTEM

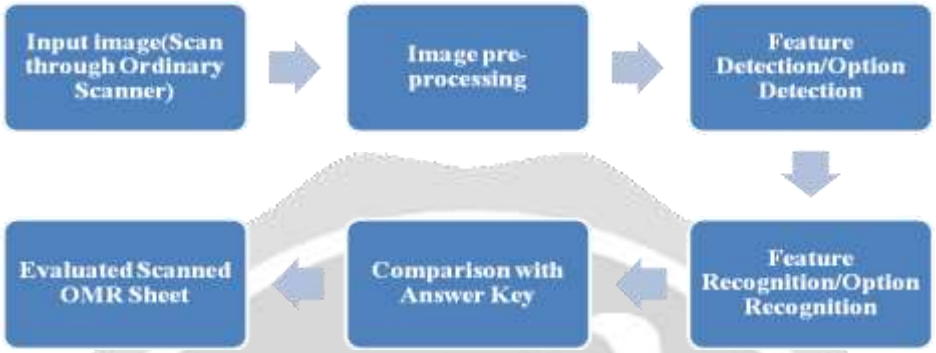


Fig-1 Schematic Diagram of Scanned OMR Sheet Evaluation

The proposed system consists of the unified solution for scanned OMR sheet evaluation. It finds four phases as shown in the figure.

2.1 Image Pre processing

The pre-processing phase consists in a set of operations that make the scanned image more suitable for the further phases. The first operation performed to the image is the conversion to gray scale; then the image is converted into black and white format using the thresholding method. Next the system does a compensation of rotation effects induced by the scanning operation. The goal of this step is rotate of image answer sheet at a calculated angle to restore it to its normal rectangle. To do that, at first we must calculate the correct angle by using Spatial domain method, and then apply bilinear interpolation method with correct angle to rotate all image answer sheet pixels to normal location.

2.2 Feature Detection

In this phase, the difference of gray level between Marked and unmarked bubble is the main feature in the classification process. To reduce the effect of noise and illumination variation, the difference in gray level of the current bubble and the background has been used. In addition to that the differences between the bubble gray level and its neighbor bubbles are added as features.

2.3 Feature Recognition

In this phase image answer sheet is projected horizontally and vertically to located answer area.

2.4 Comparison with Answer Key

In this phase we will compare the detected answers with already stored template or answer key and retrieve the output in an Excel file.

3. EXPERIMENTAL RESULTS

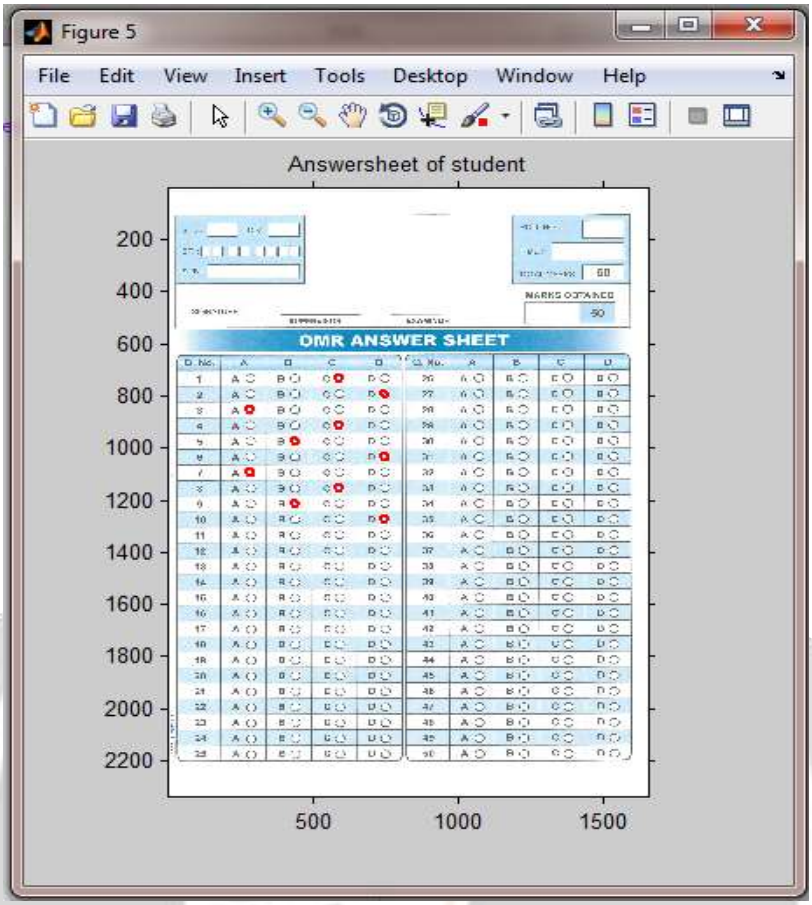


Fig-2 Detection of marked Options

As we can see from the above answer sheet, the answer given by student is, CDACBDACBD.
In the above image we have shown x cordinates of the circle detected by the system. We can compare them with the reference points obtained earlier to find out which answer has been given. The results are as below.

Fig-3 Detected Answer given by the student

The answer detected by our algorithm is same as the answer given by the student.

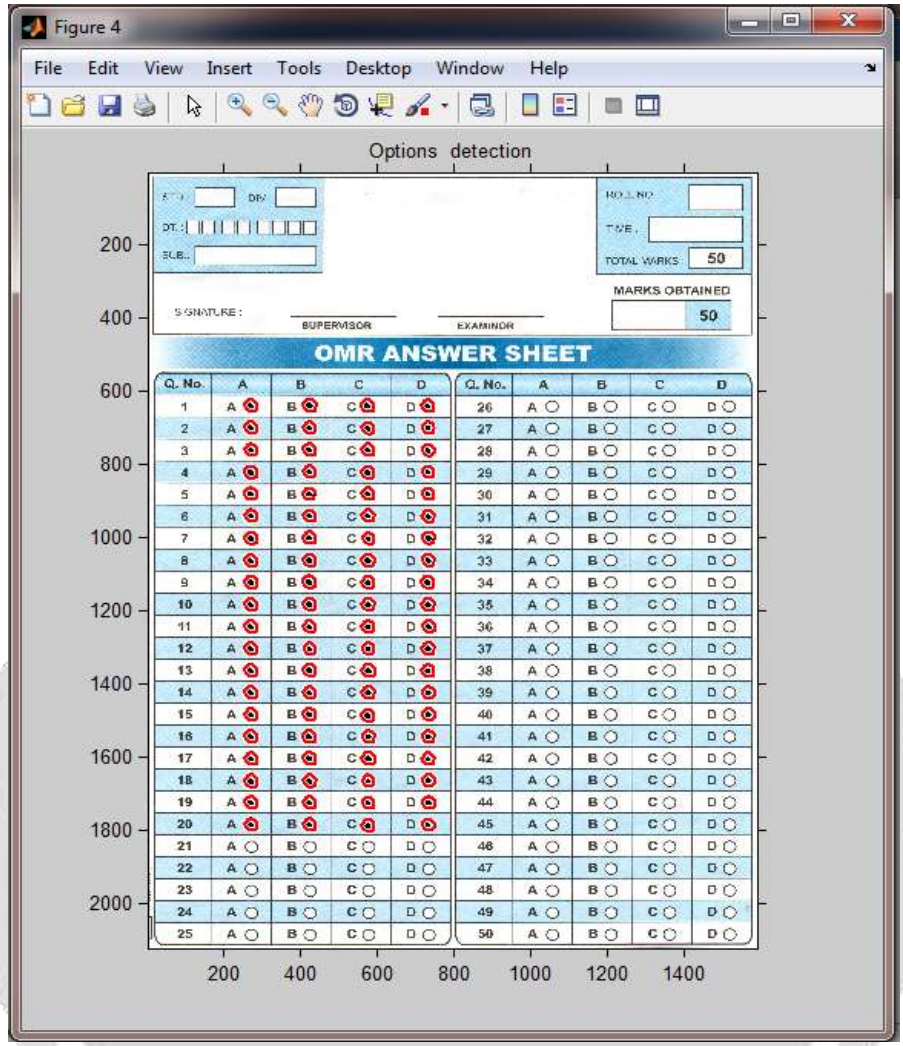


Fig-4 Detection of marked options

Answers need to shown with Classification

Case 1: If answer is not given & multiple answers marked

- In Optical Mark Recognition common issues like
  Multiple answer marked
  No answer is marked
  is detected first is must to create an error free solution.

- Here, the OMR sheet with multiple bubble marks is found. As per our concern the code is first asked for how many mark is being applied for the correct one and how many for the wrong one. We are considering '1' for correct answer and '0' for wrong answer. Every time it asks that how many marks we want to allocate.

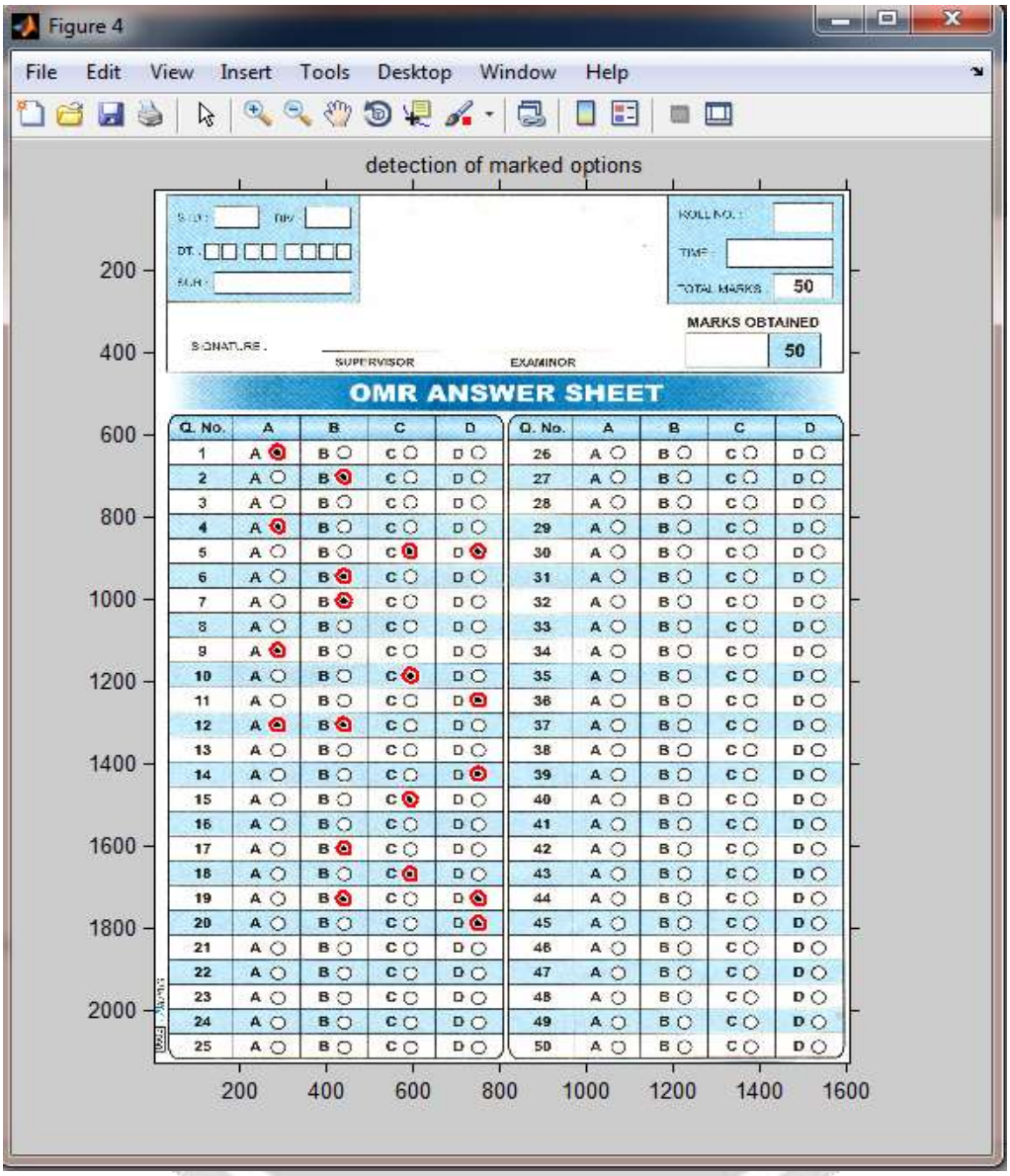


Fig-5 Detection of answer is not given & multiple answers marked

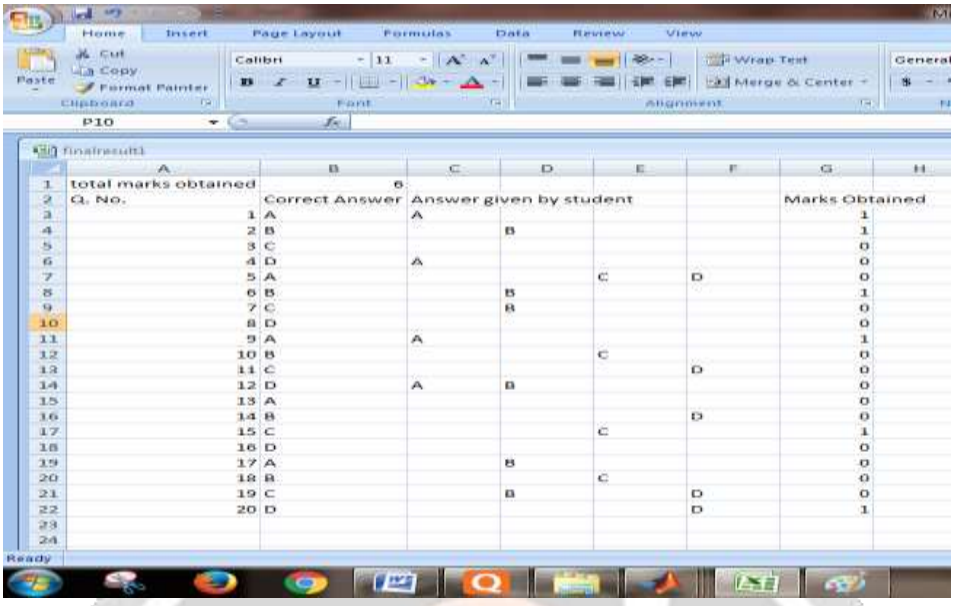
Here, we are comparing the answer sheet with 1 answers key to check the program is running well with each of answer keys.

Applying First Answer Key: A,B,C,D,A,B,C,D,A,B,C,D,A,B,C,D,A,B,C,D

Fig-6 General Output

Results of Final Output within the Excel Sheet

Final results or marks are stored with in the excel file. It retrieves particular format of mark sheet in the sense total marks obtain by student, correct answer key and the correct answer given by the students and then the total marks are generated within it.



	A	B	C	D	E	F	G	H
1	total marks obtained	8						
2	Q. No.	Correct Answer	Answer given by student				Marks Obtained	
3	1	A	A				1	
4	2	B		B			1	
5	3	C					0	
6	4	D	A				0	
7	5	A			C	D	0	
8	6	B		B			1	
9	7	C		B			0	
10	8	D					0	
11	9	A	A				1	
12	10	B			C		0	
13	11	C				D	0	
14	12	D	A	B			0	
15	13	A					0	
16	14	B				D	0	
17	15	C			C		1	
18	16	D					0	
19	17	A		B			0	
20	18	B			C		0	
21	19	C		B		D	0	
22	20	D				D	1	
23								
24								

Fig-7 Final Results

Case 2: If multiple answers marked

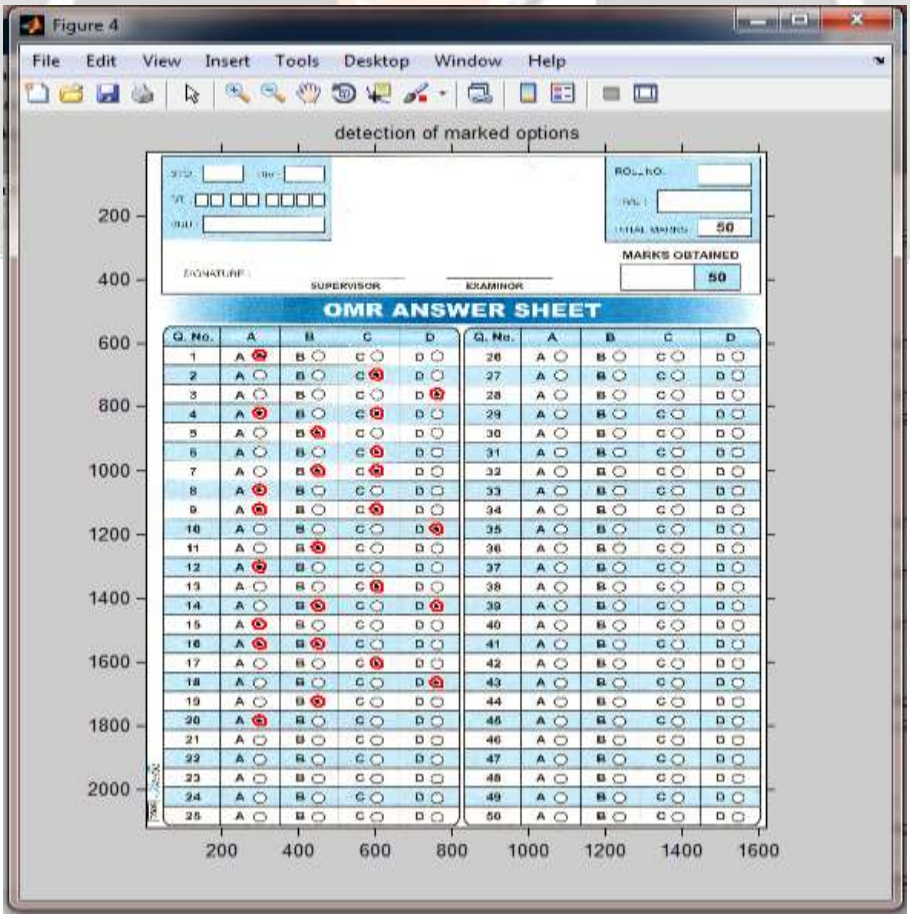


Fig-8 Detection of Multiple Marked Options

Applying First Answer Key: A,B,C,D,A,B,C,D,A,B,C,D,A,B,C,D,A,B,C,D

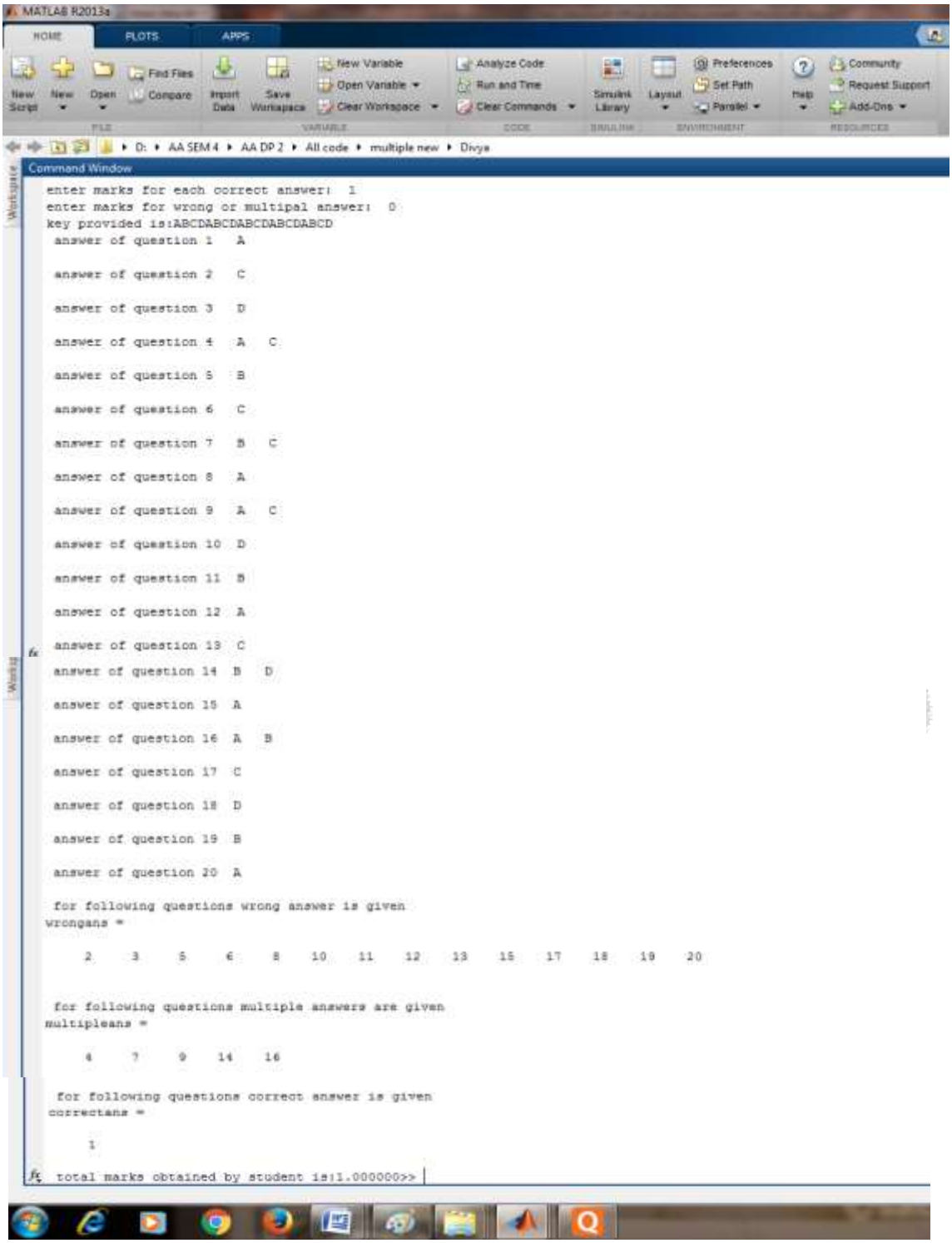
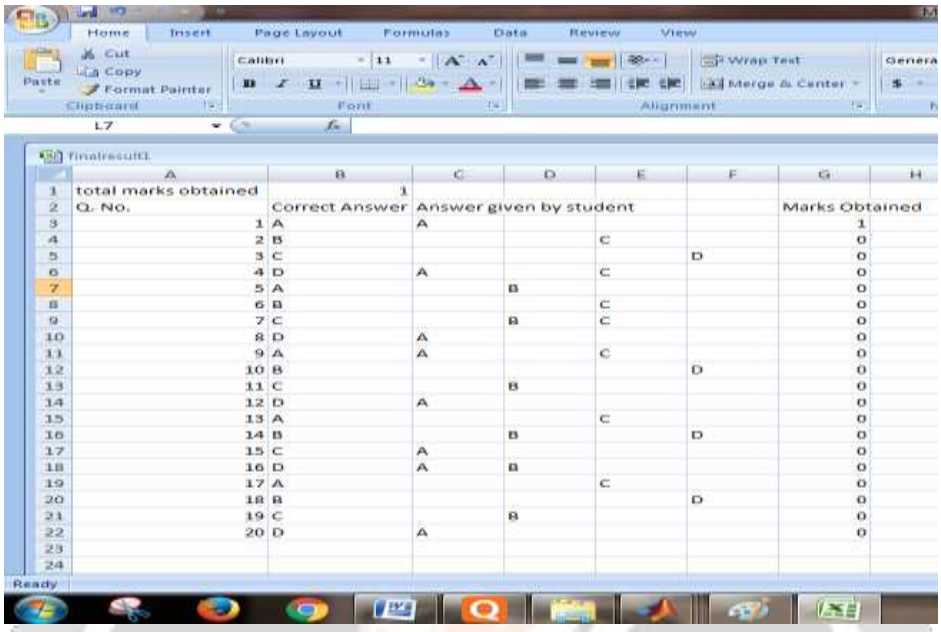


Fig-9 General Output

Results of Final Output within the Excel Sheet



	A	B	C	D	E	F	G	H
1	total marks obtained	1						
2	Q. No.	Correct Answer	Answer given by student				Marks Obtained	
3	1	A	A				1	
4	2	B			C		0	
5	3	C				D	0	
6	4	D	A		C		0	
7	5	A		B			0	
8	6	B			C		0	
9	7	C		B	C		0	
10	8	D	A				0	
11	9	A	A		C		0	
12	10	B				D	0	
13	11	C		B			0	
14	12	D	A				0	
15	13	A			C		0	
16	14	B		B		D	0	
17	15	C	A				0	
18	16	D	A	B			0	
19	17	A			C		0	
20	18	B				D	0	
21	19	C		B			0	
22	20	D	A				0	

Fig-10 Final Results

Case 3: If answer is not given

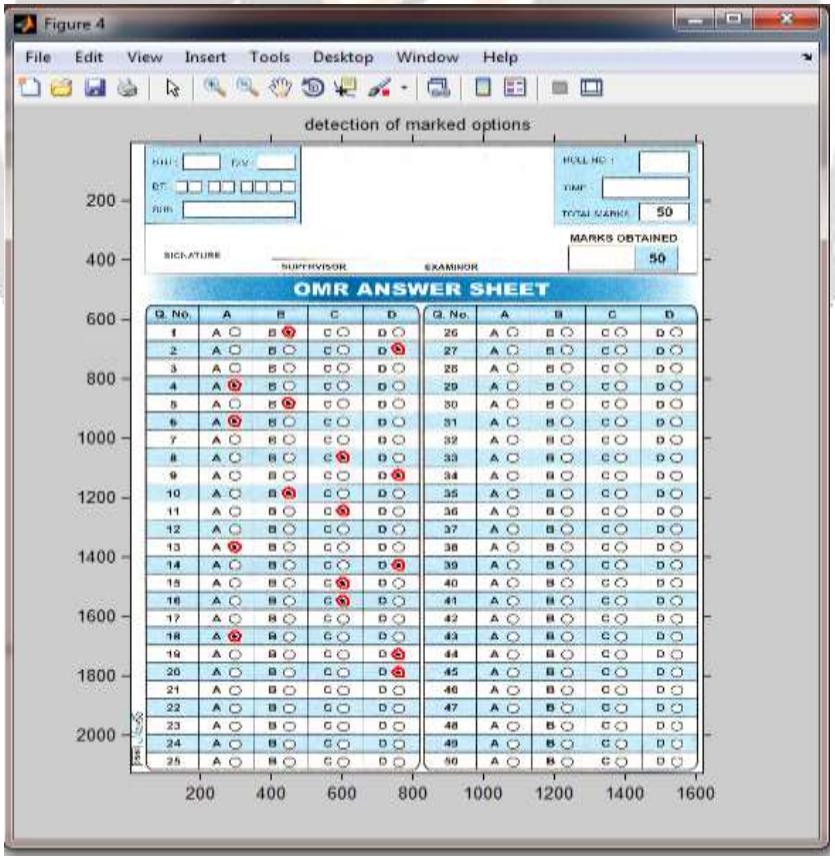
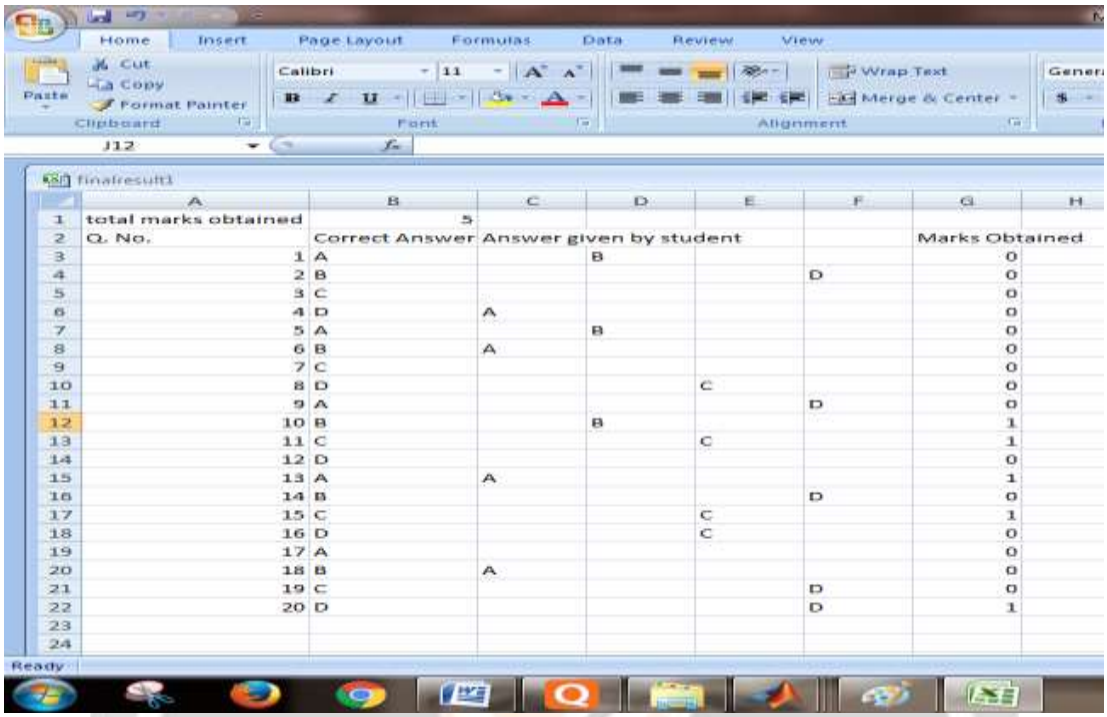


Fig-11 Detection when answer is not given

Applying First Answer Key: A,B,C,D,A,B,C,D,A,B,C,D,A,B,C,D,A,B,C,D

Fig-12 General Output

Results of Final Output within the Excel Sheet



	A	B	C	D	E	F	G	H
1	total marks obtained	5						
2	Q. No.	Correct Answer	Answer given by student				Marks Obtained	
3	1	A		B			0	
4	2	B				D	0	
5	3	C					0	
6	4	D	A				0	
7	5	A		B			0	
8	6	B	A				0	
9	7	C					0	
10	8	D			C		0	
11	9	A				D	0	
12	10	B		B			1	
13	11	C			C		1	
14	12	D					0	
15	13	A	A				1	
16	14	B				D	0	
17	15	C			C		1	
18	16	D			C		0	
19	17	A					0	
20	18	B	A				0	
21	19	C				D	0	
22	20	D				D	1	
23								
24								

Fig-13 Final Results

Case 5: If OMR sheet is tilted

If the scanned image of the form is tilted, the rotation needs to be done. It makes use of the grid present on the form and calculates the degree of rotation.
For resolving rotation, the steps to be followed are:

- Find the pixel coordinate value of top left (x1, y1) and top right (x2, y2) position of the scanned image of questionnaire form.
- The rotation angle Θ (shown in Figure 14) of the questionnaire with respect to template can be calculated by the Eq. 1:

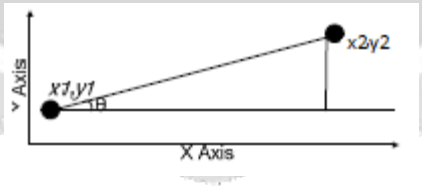


Fig-14 Rotation angle of questionnaire

To obtain the angle we have used the formula of slope

$$\text{Rotation angel } \Theta = \tan^{-1}[(y2 - y1) / (x2 - x1)] \quad (1)$$

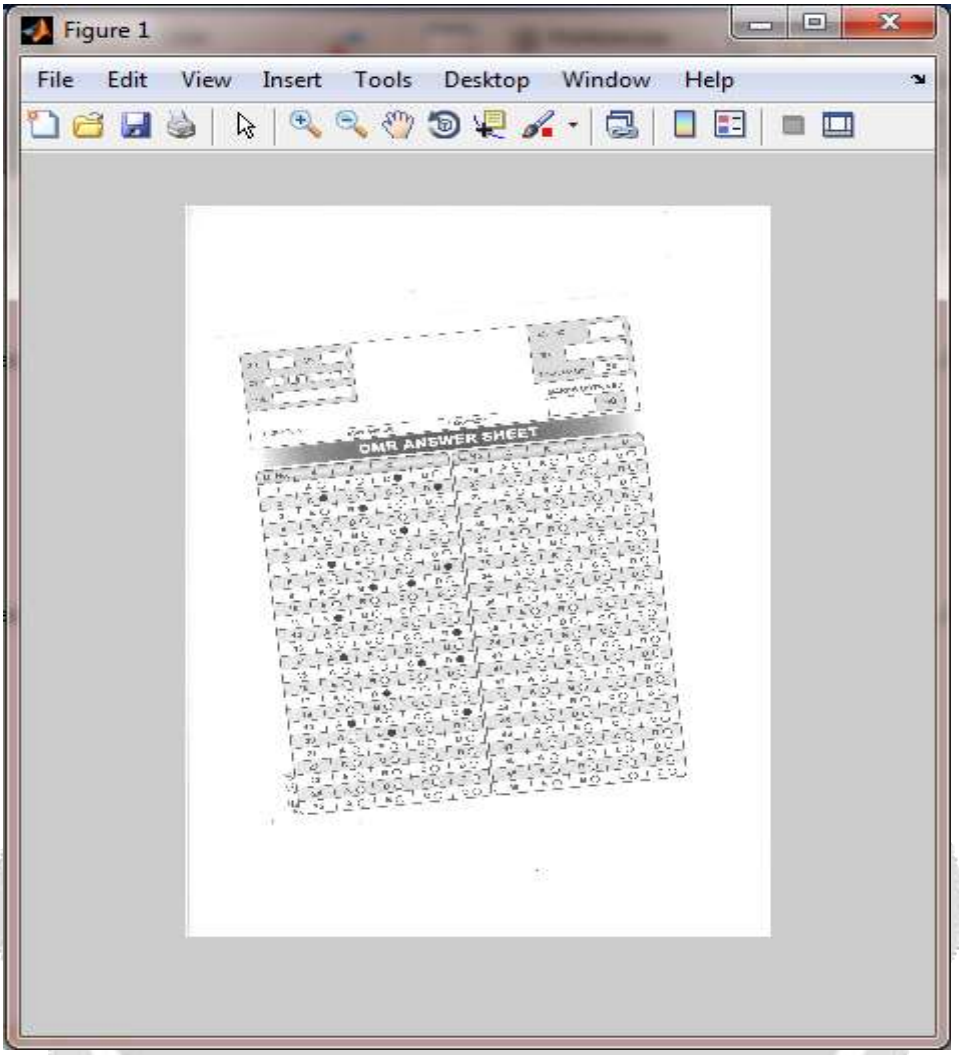


Fig-15 Tilt Image

Displaying skewed image and corrected image

This step will correct border line and then all components in the captured answersheet to be aligned based on the detected skew angle. Fig.14 shows an example of a skew corrected image after applying the proposed method.

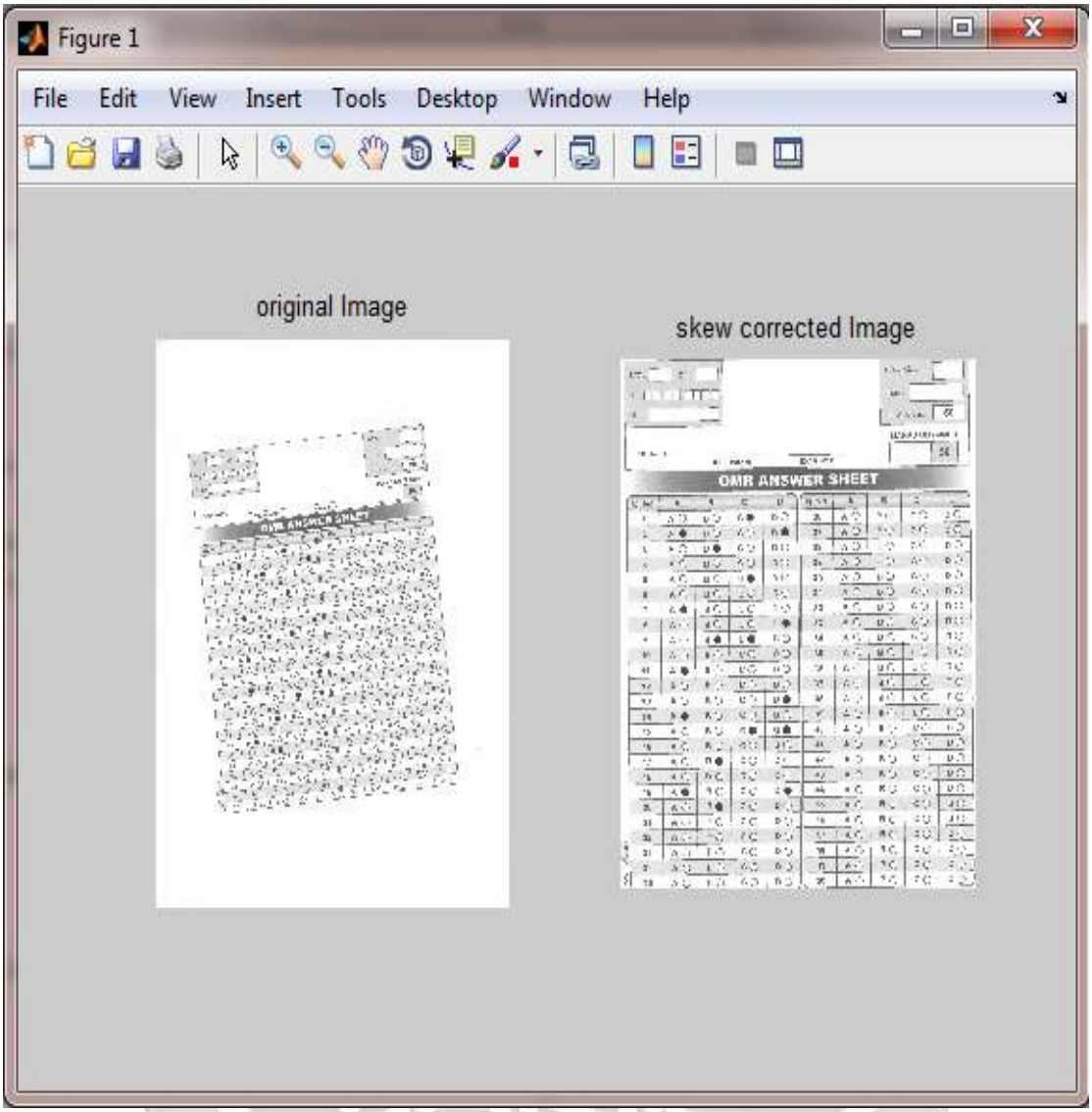


Fig-16 Skew corrected image

3. CONCLUSIONS

The Optical Mark Recognition (OMR) was developed for facilitating the MCQ scoring. The OMR machine or Optical Mark Readers are used to capture and score responses on scoring sheets that are then used by the assessor for analyzing and reporting. It is a powerful tool in scoring with accuracy and efficiency, but it is also a very expensive tool that has not seen a substantial reduction in cost even as new technologies have constantly evolved to bring technological costs lower than ever. The new OMR machines are able to perform faster and with better accuracy. However, even as the new model is priced at the same price as the earlier versions, this is still too expensive to be commonly used in the smaller sized schools or education institutes. The problem is made worse, as not only are the machines expensive, the scoring sheets are also costly. The problem is proposed to be resolved by using a normal scanner as a replacement to the costly OMR machine. The goal is to propose the system which is able to work properly with reliability and accuracy. Moreover, the operating cost is further reduced as the scanner does not require the special OMR-scoring sheets, as it is able to work with plain photocopying paper. Here, we consider the different cases such as if multiple answer marked, if answer is not given, if answer is not given & multiple answers marked and if OMR sheet is tilted.

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