

**Ministry of Education
Pedagogical Administration
Senior Division Examinations**



ROBOTIC SCANNING SYSTEM FOR SCANNING BAGRUT (MATRICULATION) EXAMINATION COPYBOOKS

**THE CONTRIBUTION OF THE TECHNOLOGICAL UPGRADE TO IMPROVEMENT OF MARKING PROCESS
AND CREATION OF DATA BASE FOR METHODOLOGICAL STUDIES.**

Dr. Moshe Decalo, Haim Hoffman

The examinations department of the Ministry of Education together with a private entrepreneur Aman-Sysnet, has harnessed advanced technology to improve automatic logistical processes to complete assessment of Bagrut examinations.

During the last year the Examination Department of the Ministry has integrated advanced technological scanning of Bagrut papers in the process of assessment of the examinations. The Examinations' Department scans by way of modern robots some one hundred thousand papers and plans to scan a further three hundred thousand in many examination subjects.

The Bagrut examinations form the basis for examining achievements of studying the national study curriculum in Israeli High-Schools. Open written examinations are performed alongside examinations held by way of various different means. The center for checking Bagrut examinations handles some one and a half million examination papers each year in a process whereby two markers check each copybook. With technological improvements the Ministry has led the way for marking exams through a secured internet site and the Ministry is now promoting the scanning of examination papers. The integration of advanced scanning technology has enabled the Ministry to improve its processes and shorten timetables. It is important to emphasize that this allows harnessing the contents that can be attained through technology to improve teaching, as the Ministry can analyze the pupils' answers to examination questions and assess the success of the teaching and the studying achievements in each subject and for each examination question separately. The scanning is in color, of a high quality and with electronic signature that assures the completeness and reliability of the original material.

Before the integration of scanning technology, the examination papers were sent to two markers, one after the other. Now using the scanning, the examination papers are sent to the markers as a scanned document that can be marked over the computer screen and the time required has been halved.

In parallel a control and management center (operational and pedagogical) has been established for the controlling supervisor of the subject. The supervisor or his representative can follow in real time the marking procedure and its quality and improve the process according to results of this tracking.

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As well as shortening timetables, the existence of examination papers in the scanned format enables the development of wide and varied educational research into the characteristics of examination answers, how pupils have handled the subject under examination, the style of answers of pupils in the Bagrut exams (high stakes) and also allows the analysis of pupils with learning difficulties, the significance of the choice of order for answering questions and analysis of the content of the answers of pupils examined with open questions; the basis of pupils answers can be a platform for technical discussion for courses for teachers, for analyzing the pupils' errors and for considering requirements for improving teaching and teaching methods

Bagrut examination results that have been processed at the level of marks per question allow a swift analysis of detail and presentation to the schools.

Directions of thought:

The steering committee set several directions of thought for the issues and dilemmas under deliberation – issues that from the basis for discussion and research. Examples of research to be decided on by the Ministry that may be examined as a result of accumulated data are as follows:

1. Analysis of the main reasons for students' errors on questions for which they received a grade lower than 55 (pass).
2. Analysis of the reasons for failure of students on questions that they began to answer but did not receive a pass mark.
3. Examine the reasons for each question in the examination why students receive borderline grades (30-50 points out of 100).
4. Study whether studies examined in the Arabic language fail on written questions of understanding text more than quantitative questions where the component of understanding text is lower.
5. Study how students with various types of learning difficulties (such as dyslexia) answer the Bagrut examination in various subjects with multiple text or quantities (such as mathematics) by a process of transferring the examination copybook through a neutral examiner.

1. The Requirements

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The accumulated material at the center for preparing the examinations will form a pedagogical basis and will improve teaching of the various subjects; information provided by the robotic scanning system allows handling of a very large amount of fast, efficient, economical and extremely reliable data and work procedures.

Details and explanations of the current situation, the professional developments and the horizons opened for research and analysis are as follows:

- 1.1. The robotic scanner is a tool that compliments (developing into the main factor) the computerized examination system, so that at the end of the day all written Bagrut examinations will be digitally converted and prepared accordingly.
- 1.2. The need to digitize the examination process arises for several reasons:
 - 1.2.1. Maintaining the credibility of the examination - from the moment the source material is converted to digital media with electronic signature it is not possible to alter the examination.
 - 1.2.2. The written copybook was the only source copy that contained the learning efforts of the student over 12 years of schooling. Loss of the copybook, even if a rare event, is unacceptable. As the copybook passes through many stations, there is a fear of it being lost. With the implementation of the scanning process and electronic signature, there is no significance to the source material.
 - 1.2.3. The continual growth of the number of Bagrut examinations creates logistical pressure on the existing system and requires alternative solutions.
 - 1.2.4. The digital copy allows first and second reviews and, if required, a third immediately afterwards and shortens logistical processes including complimentary processes such as suspicions or appeals; as a result the length of time between writing the examination and establishing the grade for the copybook is shortened.
 - 1.2.5. Until now Bagrut examinations were not kept for research purposes and in practice after the date of the examinations and appeals the copybooks could no longer be located.
- 1.3. In light of all of the above it was decided that that "small" questions (with a small number of participants) would be computerized and large questions would be scanned. This is an interim solution for several years and a computerized system is established in the schools that will enable electronic examination with a large number of participants.
- 1.4. This paper discussed the scanning system for copybooks. The system was developed and implemented by the "Marbad" (center for checking Bagrut examination copybooks) that is an arm of the examination department of the Education Ministry.

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2. The scanning system structure

2.1. The scanning system consists of 4 main components:

- 2.1.1. **Technological component** – the copybook scanning facility and the loading system
- 2.1.2. **Control component** – including an internal automated programming system for the scanning process and an external controlling system for checking the scanned material
- 2.1.3. **Logistics component** – a system for control and management of the material sent/returned from scanning
- 2.1.4. **Viewing and appraisal component** – system for viewing the scanned material which is integrated into the computerized appraisal system

2.2. In the future an "automated loading" system will be integrated into the appraisal system which will allow automatic allocation of the scanned copybooks to the appraisers (according to their authorization) without the need of manual intervention. This system will enable, amongst other things, a first and second appraisal simultaneously.

2.3. An additional system developed in parallel to the scanning system is a control and management system of the professional manager for the appraisal process (Cockpit). This system enables the professional manager logistical and pedagogical control over the appraisal system, allows for instructing appraiser during the process and taking decisions in real time.

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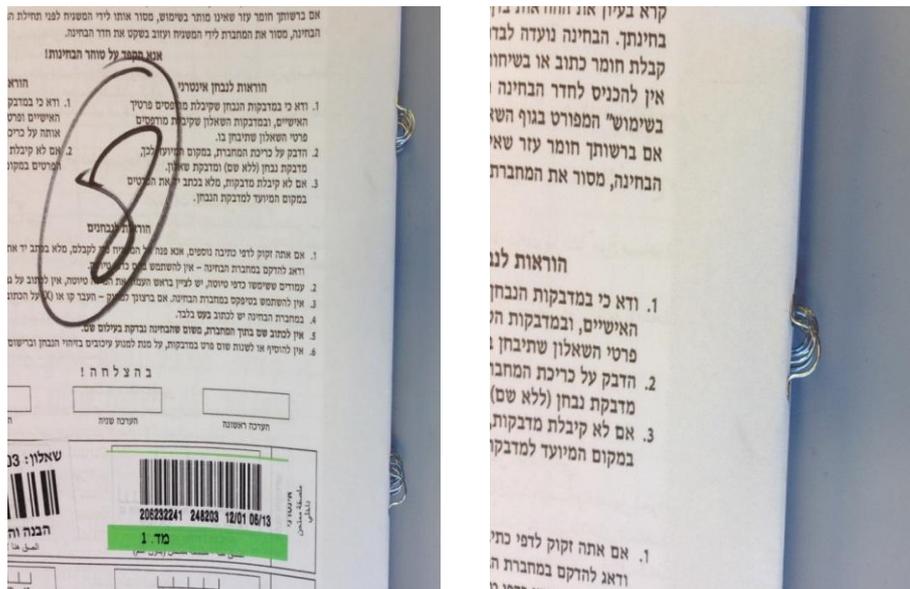
The technological system

2.4. The technological system

2.4.1. A Treventus scanner made in Austria

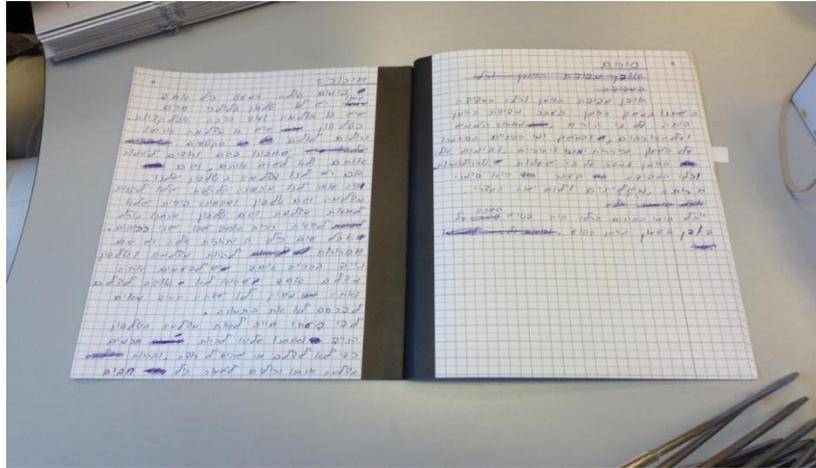


2.4.2. Copybook questionnaires designed for the scanner



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2.4.3. Loading gig (cartridge) to turn over transfer a given number of copybooks into "the book"

2.5. Below is the scanning structure that allows the scanner to simultaneously scan both sides of the page, whereby a large number of copybooks can be scanned together creating a virtual "book".



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3. Control system

3.1. The control systems built answer several major needs:

- Prevention missing pages that have to be copied before transferring the pictures to the server
- Assuring the quality of the scanner compared to the source material
- Assurance that all pages in the copybook have been scanned
- Assurance that all the copybooks in the batch/box have been scanned

4. Logistical control system

4.1. The logistical control system controls the material transferred to and returned from the scanner.

4.2. The logistical control system includes a detailed description of work and checking procedures and is operated by barcode control and reading and copying tools throughout the production line.

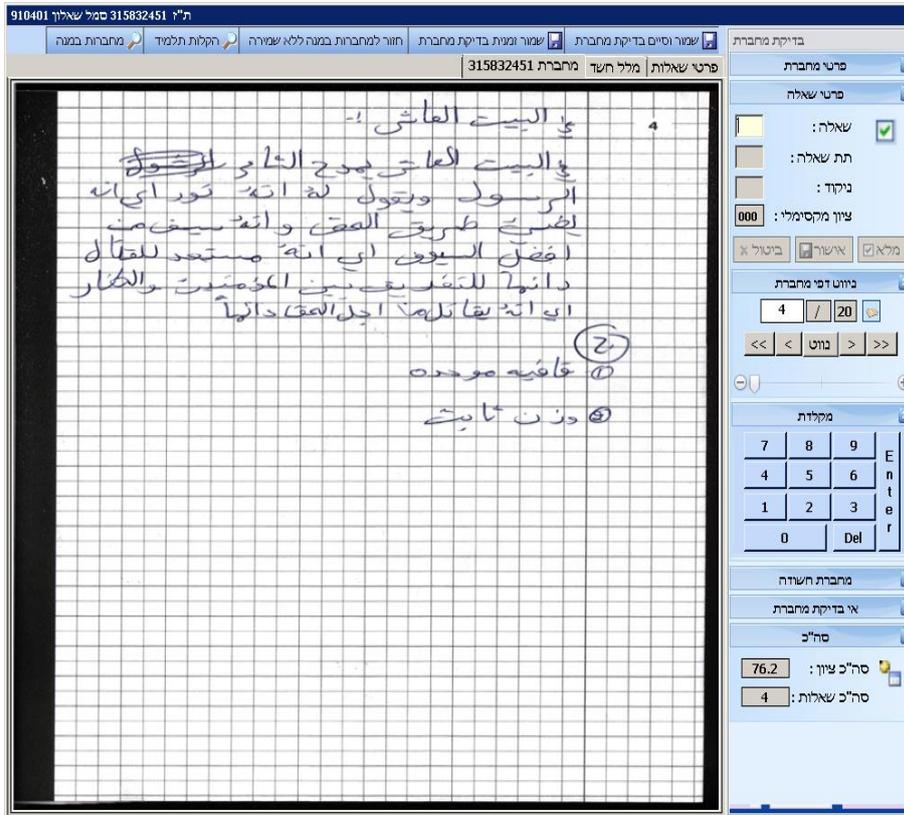
4.3. The scanning procedure is concluded when the scanned consignment arrives and each box and each item in the box is compared against source data sent for scanning.

5. Viewing and appraisal system

5.1. The scanned copybooks are integrated into the central appraisal system

5.2. The viewing screen is designed so the appraiser can simultaneously see the scanned material and the system through which the copybook is marked.

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5.3. The scanning is designed for a very high resolution so the result on the screen is very clear.

5.4. It's possible to zoom to a particular part of the scanned screen.

5.5. Sometimes the appraiser is required to check 2 pages of the copybook together because of the sequence of the answers. In this case it's possible it's possible to see 2 pages whilst the marking keypad is dynamic and can be moved to any point on the screen.

5.6. For the viewing experience we have used an element of human engineering and established maximum comfort for the appraiser, together with efficiency and effective use of time.

Following several experiments and a pilot project the above system was fully operated for certain subjects and led to fully satisfactory results, improvement in procedures, time saving, convenience and simplicity of operation, establishment of a wide and flexible data base that allows for research and examination work. As a result, the system will be operated for most of the Bagrut examinations and it is accessible, convenient and efficient for use for other similar issues in the educational field and in other fields.

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