**Literature Review & competitors**

**Real-Time Whiteboard Transcription System**

**Introduction**

Optical Character Recognition (OCR) is an advanced technology in image processing that enables the conversion of visual content into readable digital text. In the modern educational era, students face challenges documenting complex lecture materials, particularly reading from classroom boards. Our project proposes an innovative solution that integrates advanced OCR capabilities to recognize Hebrew and English text, mathematical symbols, and visual content, converting them into readable digital files. This solution addresses students' difficulty in transcribing lecture materials while listening and ensures accurate transcription of visual content from lessons in real time.

**Project Goals**

* Develop a user-friendly system for real-time text transcription from whiteboards.
* Integrate advanced OCR and image processing technologies to recognize text, symbols, and mathematical formulas.
* Adapt the system to multiple languages, including English and Hebrew.
* Create an interface that allows quick and easy export of transcribed content.

**Approach**

* Develop a video processing module to detect and save relevant frames from the whiteboard.
* Integrate OCR engines, such as Tesseract, for text transcription.
* Implement AI-based algorithms to recognize mathematical symbols.
* Design and build an intuitive and user-friendly interface.

**Expected Challenges**

* **Handwriting Recognition:** Identifying handwriting is a technological challenge requiring AI-based algorithms and extensive datasets to train models.
* **Low-Quality Images:** Visual noise or blurry text in images can reduce text recognition accuracy.
* **Mathematical Formulas:** Recognizing formulas requires a general understanding of the symbols and data related to the problem's context, not just direct visual recognition.
* **Hebrew:** Reading right-to-left text requires specific adaptations in existing OCR technologies.

**Metrics for Success**

To measure the system's performance and its impact on students' learning experience, we will use the following metrics:

1. **Accuracy Rate:** Test transcription quality and error detection in texts from various image formats (images or videos).
2. **User Feedback:** Gather feedback from students, lecturers, and other users on the system's usability and its impact on their learning capabilities.
3. **Improvement in Exported Content:** Evaluate whether exported files meet users' needs, including format and information organization.
4. **Usability in Diverse Conditions:** Assess the system's performance under varying classroom conditions, including lighting and camera angles.

**Competitors**

**Google Lens:**

* **Features:** Allows users to take a picture and receive transcription of the text in the image.
* **Advantages:** Accurate in recognizing English and other printed text, performs well with printed materials.
* **Disadvantages:** Less effective with handwritten text; lacks real-time video capabilities.

**Microsoft OCR:**

* **Features:** Part of the Azure Cognitive Services package. Offers text recognition solutions in images and video clips.
* **Advantages:** Integration with other Microsoft platforms, supports cloud applications.
* **Disadvantages:** High costs for enterprise use; requires customized integration.

**OpenCV:**

* **Features:** An open-source image processing library offering many tools for text recognition.
* **Advantages:** Flexible and available for use in various projects.
* **Disadvantages:** Requires significant technical knowledge and custom development for real-time solutions.

**Our System's Innovation**

Our system will integrate several existing technologies, such as image processing via OpenCV and Tesseract for text recognition, along with tailored models for recognizing mathematical formulas and handwritten text in Hebrew and English. Unlike existing tools, our system offers a real-time solution, intelligently processing changes on the whiteboard and retaining relevant information. It is tailored to diverse learning environments, with quick export capabilities to text or Word files. The system handles different reading directions, such as Hebrew right-to-left and English left-to-right, and automatically ignores erased or modified information on the board. The solution combines precision, efficiency, and flexibility, while its simple and accessible interface ensures a comfortable user experience for all users, even without technical backgrounds.

**References**

Tesseract OCR

"Tesseract: An Open Source OCR Engine,"

<https://github.com/tesseract-ocr/tesseract>

The Tesseract library is one of the most popular in the OCR world, providing a free and accessible solution for text recognition in images and documents. Numerous articles and studies describe the use of Tesseract in various image processing scenarios

OpenCV: Computer Vision Tools

Bradski, G. (2000). "The OpenCV Library." Dr. Dobb's Journal of Software Tools.

<https://opencv.org/>

OpenCV is a popular image processing tool enabling real-time video analysis, including object and text recognition in images. The article presents OpenCV's many uses, including in contexts of text recognition in various languages and dynamic conditions.

Optical Character Recognition and Handwritten Text

Awan, I. A., & Lee, Y. K. (2018). "Handwritten text recognition using deep learning techniques: A review." Journal of Visual Communication and Image Representation, 56, 264-279.

<https://doi.org/10.1016/j.jvcir.2018.02.014>

This research examines the latest methods for handwritten text recognition using machine learning and deep learning, highlighting the pros and cons of various approaches to handwriting processing.

Handwriting Recognition Systems

Jayadeep, R., & Bindu, P. (2016). "Handwritten text recognition: A review of techniques and trends." International Journal of Computer Applications, 141(9), 7-12.

<https://www.ijcaonline.org/>

This article provides a comprehensive review of various techniques for handwriting recognition, presenting challenges and opportunities in this field. The problem of real-time handwritten whiteboard text recognition is discussed in general terms.

Vision Transformers for OCR

Dosovitskiy, A., & Brox, T. (2016). "Discriminative Unsupervised Feature Learning with Exemplar Convolutional Neural Networks." IEEE Transactions on Pattern Analysis and Machine Intelligence, 38(9), 1734-1747.

<https://doi.org/10.1109/TPAMI.2015.2490979>

This study introduces the use of Vision Transformers as an alternative to CNNs in text recognition, explaining the advantages of these approaches in recognizing dynamic objects under varying conditions.